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10
147
A07

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USSR: Engineering & Equipment

JPRS-UEQ-88-001 13 JULY 1988

CONTENTS

INDUSTRIAL ENGINES, MOTORS

MACHINING EQUIPMENT

NAVIGATION, GUIDANCE SYSTEMS

NON-NUCLEAR ENERGY

NUCLEAR ENERGY

PLANNING, RESEARCH, ECONOMICS

Test of TU-155 Airplane with Cryogenic Fuel System

18610189a Moscow PRAVDA in Russian No 108, Apr 88 p 3

[Excerpt] The world's first airplane capable of using cryogenic fuels took off on April 15. Thus began flight tests of an experimental aircraft, the TU-155, which uses liquid hydrogen and liquefied natural gas as fuels.

This airplane was developed by personnel of the Design and Experimental Bureau imeni Tupolev in collaboration with the Scientific Research Institute of the Aviation industry. Installed in the airplane is an NK-88 engine designed by the bureau which academician N.D. Kuznetsov heads. A large number of enterprises and scientific research institutes took part actively and creatively in the development of systems of the airplane.

Its crew, which is headed by V. A. Sevankayev, a meritorious test-pilot of the USSR, has opened a new page in the history of Soviet and world airplane building.

In our country, work on the development of airplanes using cryogenic fuels began with the development of an experimental aircraft.

The TU-154, which has already been introduced, was chosen as the base model. A special section in the rear of the passenger compartment of such an airplane was equipped for the installation of a liquid-hydrogen tank.

Scientific research work was done, and more than 30 onboard systems which ensure operation of the airplane's cryogenic propulsion plant, fire safety and explosion proofing, were designed and produced.

A unique ground complex was developed for the support of fueling and maintenance of the airplane.

02291

Numerical Solution of Problem of Stress Concentration in Shell T-Joint

18610158a Kiev PRIKLADNAYA MEKHANIKA in Russian No 12, Dec 87 (manuscript received 11 May 85) pp 72-79

[Article by I.P. Yermakovskaya, A.S. Strelchenko, I.G. Strelchenko and L.A. Sheptun, Mechanics Institute, AN USSR [Ukrainian SSR Academy of Sciences], Kiev]

[Abstract] The stressed state of thin elastic orthotropic cylindrical shells that intersect at a right angle, wherein the primary elasticity directions coincide with the primary lines of curvature, was examined. The stressed state problem was solved by first solving the problem of displacements with subsequent application of the numeric finite difference method. The stressed state was assumed to consist of the main zero-moment state and an excited state, the latter being described by equations of the flat shells theory. Formulae for components of the main and the excited stressed state were derived. The derived system of differential equations was solved, using a combined numeric-analytical method. An algorithm for solving the problem on a computer was developed. The method was implemented as software for a BESM-6 computer within the framework of the DISPAK operating system and for an YeS-1040 computer within the framework of the OS YeS operating system. Numerical experiments were conducted, and their results are tabulated. Figures 1, tables 3, references 6: 5 Russian, 1 Western.

12770

Thermal Conductivity of Synthetic Diamond Single Crystals

18610180a Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR: SERIYA A, FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 10, Oct 87 (manuscript received 21 Jun 85) pp 74-77

[Article by M.Ya. Katsay, A.P. Podoba, T.D. Ositinskaya, A.A. Shulzhenko and V.G. Malogolovets, Superhard Materials Institute AN USSR [Ukrainian SSR Academy of Sciences], Kiev; presented by Academician AN USSR, N.V. Novikov]

[Abstract] The effect of growth conditions on thermal conductivity of synthetic diamond single crystals in the case of spontaneous mass crystallization was studied. Transition metals in the iron group and their alloys were used as solvents. In the reaction space, disks of spectrally pure graphite were alternated with layers of the solvent metal. Synthesis was performed with a controlled temperature gradient in the reaction space. Crystallographic and morphological features of synthesized specimens were studied visually, using an MBS-9 microscope. Thermal conductivity of single crystals was determined, using the heat flow constriction method. The presence of impurities in diamond single crystals was determined from IR absorption spectra. Changing carbon concentration in the crystallization medium in the process of growth virtually had no effect on the speed of graphite-diamond transformation, but significantly affected properties of crystals. Introduction of nitrogen getters into reaction medium significantly affected morphological features of diamonds. A correlation between thermal conductivity and paramagnetic nitrogen concentration was observed, but it was noted that this correlation should not be considered a characteristic of all synthetic diamonds. It was suggested that nitrogen impurities could serve as an indicator of changing conditions of crystal growth. By combining control of the growth rate with reduction of the overall concentration of nitrogen impurities in crystallization medium, it will be possible to increase thermal conductivity of synthetic diamonds, bringing them up to the level of the best natural diamonds. Figure 1, references 11: 6 Russian, 5 Western.

12770

UDC 621.397.331

Principles of Designing Polyhedron Scanning Mirrors for Atmosphere Probing Laser Systems

18610201a Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30, No 9, Sep 87 (manuscript received 10 Dec 86) pp 81-88

[Article by A.B. Panov, G.A. Brovtsinov, and M.A. Valygina, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] The problem of a scanning receiver-transmitter channel for an atmosphere probing laser instrument is considered, rotating regular mirror prisms and mirror pyramids being most practicable for periodic deflection of the laser beam. The relations between angles in these polyhedra and beam deflection angles, essential for design and performance analysis, are established in accordance with geometrical optics and trigonometric laws. Scanning through up to 240 degrees is found to be achievable with either a pyramid or a prism; for pyramids the scanning angle is a complex trigonometric function of the number N of lateral faces and their angle of inclination of, while for prisms (d=90 degrees) the scanning angle reduces to simply 4TT/No. The beam utilization factor is found to decrease almost linearly with increasing ratio of beam diameter to length of beam trace on a face, but is relatively independent of the number of lateral faces. In the case of a pyramid there occurs a curving or deflection of the scan line during flight of the "laser sonde" carrier, this curvature reaching a maximum of d=40 degrees and then becoming again zero at d=90 degrees (prism). It however decreases with increasing number of lateral faces so that a tradeoff with the scan range is required. The article was presented by the Department of Optoelectronic Devices. Figures 8; tables 1; references: 3 Russian.

2415/12913

UDC 536.64

Theoretical Principles Underlying Pulsed Mode Operation of Inhomogeneous Radiation Detectors Based on Thermoelastic Effect in Crystalline Quartz

18610205 Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30, No 10, Oct 87 (manuscript received 17 Apr 87) pp 74-82

[Article by G.G. Ishanin, V.I. Lukyanov, and S.V. Tikhonov, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] A quartz crystal thermoelastic radiation detector has been developed at the Leningrad Institute of Precision Mechanics and Optics for radiation measurements, this device having an inhomogeneous structure which consists of a thin (less than 0.2mm) X-cut quartz crystal slice with one face glued to a heat-conducting damper and the active opposite face covered by a metal (in this case Ni) electrode coating under a layer of a broad-spectrum radiation absorber. Its metrological characteristics, namely accuracy and dynamic range, when measuring the energy of radiation pulses rather than continuous radiation flux are calculated within a design and performance analysis on the basis of its thermophysical model and equivalent electric circuit. The error can be as much as 45 percent for very short (0.1 us) pulse durations, falling well below 10 percent as pulse durations increase beyond 10 us. Allowable pulse energies (less than that for oc to B phase transition and attendant loss of piezoelectric property) fall off rapidly from 30 J at 1 ms pulse duration. The article was presented by the Department of Optoelectronic Devices. Figures 7; references: 3 Russian.

2415/12913

Reflection Spectra Of Metal-Dielectric Light-Absorbing Coatings

18610202a Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 87 (manuscript received 5 Nov 86) pp 3-5

[Article by A.V. Dotsenko, A.M. Yefremov, S.A. Kuchinskiy, E.I. Levitina, and V.M. Chekmarev]

[Abstract] The reflection spectra of thin metal-dielectric light-absorbing coatings, Cr-SiO and Al-MgF_2 coatings with 0-0.95 volume fractions of metal, were measured with a Hitachi spectrophotometer in normally incident radiation of wavelengths covering the 400-2,400 nm range. The thus experimentally determined values of the energy reflection coefficient, also absorption coefficient, are compared with theoretical effective values for monochromatic waves according to Landau-Lifshits relations and the Maxwell-Garnett relation for effective dielectric permittivity. The agreement is found to be adequately close for coatings with up to 0.76 volume fraction of metal in long-wave radiation, theoretical calculations overestimating the reflection coefficient for shorter-wave radiation. Figures 4: references 13: 11 Russian, 2 Western.

02415/09599

Reflectometry of Metal Mirror Surfaces

18610202c Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 87 (manuscript received 10 Dec 86) pp 7-8

[Article by V.N. Morozov and Ye.V. Smirnova]

[Abstract] An experimental study of aluminum and copper mirrors was made, aluminum being characterized by a high reflection coefficient over a wide radiation spectrum and copper being characterized by a high thermal conductivity desirable in power optics. The purpose was to determine the dependence of the Fresnel reflection coefficient on the surface finish and on the incidence angle. Nine different aluminum mirrors were tested: single crystals with (111)-plane surface or (100)-plane surface electrolytically polished, polycrystalline electrolytically polished with cooling or without cooling but with subsequent annealing, or mechanically polished, and aluminum coatings vacuum-deposited on optically polished quartz glass (5×10^{-9} torr, 10^{-5} torr), glass substrate (5×10^{-5} torr), or sapphire (5×10^{-9} torr). The reflection coefficient was measured with a spectroscope having a 10-20 degree aperture, to radiation of the 632.8 nm wavelength and incident at a 1-20 degree angle. Mirrors of crystalline aluminum electrolytically polished with cooling were found to have the highest reflection coefficient. Copper mirrors with various degrees of surface roughness were tested for the reflection coefficient to radiation of 2.5-600 nm wavelengths (0.05-2 eV), for comparison with available data. Figures 1; tables 2; references 12: 2 Russian, 10 Western.

02415/09599

Problem of Steady-State Heat Conduction and Thermoelasticity for Perforated Mirrors in Astronomical Instruments

18610202d Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 87 (manuscript received 17 Dec 86) pp 9-10

[Article by M.A. Grach, Ye.V. Nisevich, V.I. Novoselov, V.Ye. Prediger, and Yu.P. Shemko]

[Abstract] In order to facilitate computer-aided design and performance analysis of perforated mirrors, perforation being necessary for safe weight reduction for use in astronomical instruments, the problem of steady-state heat conduction and thermoelasticity is formulated as a displacement minimization problem in potential energy and is solved by the method of finite elements. The

resulting matrix equation of equilibrium relates the vector of nodal displacements to the matrix of generalized loads through the stiffness matrix as proportionality factor. The available analytical apparatus and computer program packet were applied to two circular plane mirrors of heat-resistant glass, their blanks having different inside and outside radii with the thickness increasing from bore to periphery. Each mirror is to be perforated into a regular repetitive pattern of identical circular holes. The temperature field and the axisymmetric strain field were calculated, assuming a normally incident thermal flux of 10 W/cm^2 and all mirror surfaces except the reflecting one in contact with air at room temperature. These calculations have yielded axial and radial temperature profiles in various sections, also deflection profiles of the front surface. Figures 4; references 6: 3 Russian, 3 Western.

02415/09599

Design of New Compensator Configurations for Quality Control of Optical Elements

18610202e Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 87 (manuscript received 30 Dec 86) pp 16-18

[Article by N.N. Kulakova]

[Abstract] Three new types of compensator ensuring congruence of image and object during inspection and quality control of large optical elements such as astronomical telescope lenses and mirrors have been invented which require only one axial displacement relative to a point source of light for changing the magnitude of aberration induced by such a compensator. The type-I compensator consists of three convexo-concave lenses, a negative one between two positive ones. The type-II compensator consists of two lenses, a convexo-concave negative one followed by a convexo-plane positive one. The type-III compensator consists of two identical afocal lenses, a convexo-concave one followed by a concavo-convex one. Their design is based on applicable relations of geometrical optics. The type-III is most advantageous from the standpoint of design simplicity and manufacturability. The design is illustrated on one example of each type, with radii and thicknesses of lenses as well as distances between lenses having been calculated, assuming that all lenses are made of the same material which has a refractive index n = 1.51466 and are separated by air. Figures 6; references 2: 1 Russian, 1 Western.

02415/09599

Comparative Studies of Optical Properties of Copper Mirrors Produced by Various Methods

18610202f Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 87 (manuscript received 10 Dec 86) pp 36-39

[Article by F.Kh. Vakhitov, V.M. Zimin, and R.B. Tagirov]

[Abstract] An experimental study of copper mirrors produced by three different methods was made, for the purpose of determining the dependence of their reflectance over the 300-800 nm range of radiation wavelengths on the quality of the surface layer and on the thickness of the oxide film. These were mirrors ground and then polished to a class-13 surface finish, mirrors precision-turned with a diamond tool, andmirror coatings deposited on substrates by the vacuum evaporation process. Some of each were annealed and some were not. Their surface was examined by the Fizeau method under an MMU-3 microscope for a determination of maximum groove depth and average groove width. The total reflection coefficient was measured with a photometer inside a sphere. The coefficients of specular and diffuse reflection were measured with a "Spekol-10" high-precision instrument and with a high-precision laboratory reflectometer built by the authors. The data have been processed according to the Lawerg-Wilkinson relation so as to separate the specular component and the diffuse component of reflectance. With the aid of additional experiments and theoretical analysis have also been determined the diffraction characteristics of these mirrors, of significance being first-order and second-order maxima. The results indicate a general degradation of optical properties by strains in the surface layer.

02415/09599

Thermal and Electrical Conductivities of La_2S_3 Optical Ceramics

18610202b Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 87 (manuscript received 24 Sep 86) pp 5-6

[Article by G.G. Gadzhiyev and B.N. Magdiyev]

[Abstract] An experimental study of La_2S_3 ceramic crystallized from the melt and recrystallized by compaction under vacuum was made, for the purpose of determining the temperature dependence of its thermal and electrical conductivities over the 300-1,300 K range. Thermal measurements were made by the Kh.I. Amirkhanov method, accurate within 5 percent up to 1,200 K. Electrical measurements were made on a d.c. bridge with a dynamic electrometer, accurate within 0.5 percent up to 10^{10} ohm, and by the 3-point method. Both plane-parallel and cylindrical specimens were tested in a pure argon atmosphere. Their density was measured by hydrostatic weighing in toluene and their microhardness was measured with a PMT-3 tester. The data are compared with the conductivities of cast ceramic. The thermal conductivity of compacts is found to be increasingly lower with rising temperature, there being no photon component. The electrical conductivity of both ceramics is found to increase exponentially with rising temperature, that of compacts remaining higher but decreasingly so with rising temperature. Figures 2; tables 2; references 9: 7 Russian, 2 Western.

02415/09599

Improved Metrological Support: Important Reserve of Improving Product Quality in Machine Building Industry
18610176b Moscow STANDARTY I KACHESTVO in Russian No 3, Mar 88 pp 105-108

[Article by I.V. Shmayov and V.A. Bryukhanov (VNIIMS) [All-Union Scientific Research institute of Metrology and Standardization]]

[Text] The 4th All-Union S&T Conference that took place in Odessa was devoted to problems of improving metrological support of machine building sectors of national economy and increasing its role in acceleration of S&T progress. It was organized by Gosstandart SSSR [USSR State Committee for Standards], VSNTO [All-Union Council of S&T Societies], Central and Odessa Boards of NTO [S&T Society] "Priborprom" and Odessa TsSM [Standardization and Metrology Center].

Managers of organizations and enterprises, professionals from agency metrological departments and State acceptance bodies, workers of leading metrological institutes and territorial bodies of Gosstandart SSSR, all in all over 700 representatives of 45 Ministries and agencies from 47 cities and towns took part in the Conference.

Head of Metrology Administration, Gosstandart SSSR, L.K. Isayev opened the Conference.

At plenary sessions, papers were presented on problems of improving the level of metrological support in order to improve product quality under the conditions of enterprises and associations retooling, expanded independence and conversion to full self-accounting [khozraschet] and self-financing. In particular, special attention was paid to ensuring unity of measurements in the machine building industry, improving the accuracy of measuring instruments (MI) in quality control, application of QC methods and equipment in flexible manufacturing systems (FMS) and robotic complexes (RC) and expanding the fleet of MI at metrological departments of machine building enterprises and industries.

Conference participants discussed working experience of collectives in improving the quality and competitiveness of products of the machine building industry, using as an example implementation of the Leningrad "Kachestvo" [Quality] program. Fulfillment of this program will make it possible by the end of the 12th Five-Year Plan to manufacture at least 85% of the most important products in the region at the level of the best world achievements.

A number of important problems were discussed at sections sessions.

For instance, section "Measurement Problems in Robotics and FMS Technology" examined organizational, technical and scientific methodological features of metrological support of FMS and RC and goals in improving the quality and reliability of products made by these systems and complexes. The need to equip FMS and RC with the newest control and measuring instruments, develop control methods using built-in MI and improving methods for diagnosing and testing these systems and complexes was specially stressed.

A special section was devoted to problems of metrological support in the area of design and development of machine building products using ASUTP [automated process control systems] and other automated systems that widely use microprocessor technology. The section aslo examined results of development of methods and means for automated control of parameters of products made in mass and series production (including control of linear dimensions), building test stands and stations, metrological certification of ASUTP elements etc.

Section "Role of Measurements in Assessing Product Quality in Machine Building Industry" discussed problems of improving the system of product quality indices while taking into account more stringent metrological requirements; methods for assessing product quality as far as "leading indicators" are concerned; problems of assessing the validity of control results; the effect of quality of MI calibration on the efficiency of the outgoing inspection etc. It also touched upon problems of improving the functioning of metrological subsystems within the KSUKP [integrated system for product quality control] framework, and specific features of organization of work on metrological support under the conditions of restructuring of the business mechanism taking into account the use of economic criteria of product quality control.

Section "S&T, Methodological, Economic and Legal Aspects of Ensuring Unity of Measurements in Machine Building Industry" discussed the work on optimization of metrological service of MI at industrial enterprises, methods for purposeful planning and evaluation of economic efficiency of work in the area of metrological support, problems of improving agency calibration of MI and the level of respective NTD [technical standards documentation], and legal problems. A number of papers were dealing with problems of improving efficiency of measuring techniques and regulation thereof in technical standard, design and manufacturing documents, and with regulating the work on metrological certification.

Special attention was paid to developing a file of State and industry standards that establish basic requirements to metrological support, controlling its level during State acceptance of products, developing forecasting methods in the area of metrological support and improving the standard base of State MI tests.

The Conference touched upon a large number of serious problems and identified "bottlenecks" that cause difficulties in ensuring high quality of a number of important products of the machine building industry (such as

components of the connecting rod-piston group, camshafts, involute spline shafts etc.). For instance, not everything is going well in developing measurement methods in testing diesel fuelmetering equipment, nondestructive methods for hardness measurment, forces and deformations under load, methods for nondestructive testing of the surface layer of rapidly wearing parts, noncontact methods and instruments for measuring temperature when preheating parts before welding and during induction hardening, methods and means for automated control of parameters of large bearing etc.

Machine building enterprises feel an acute shortage of reference measuring instruments (end standards of the meter, reference V-blocks, machinist's straight edges and squares, interferometers, surface tables, thread gauges etc.) used for instrument calibration in mass and series production.

Manufacturing of high-quality machine building products is often impeded due to insufficient attention to solving metrological problems when developing design and manufacturing documentation. It was stressed that one of the reasons of manufacturing defects is the lack of necessary measuring and control instruments (especially from the Soyuzglavinstrument nomenclature) and unsatisfactory situation in providing enterprises with reliable sensors of various physical parameters. Minstankoprom SSSR [USSR Ministry of Machine Tool and Tool Building Industry] is behind in the development and manufacturing of reference instruments and measures, as well as working measuring instruments, that are at the world level.

According to Conference participants, the low level of metrological support of machine building industries is to a large extent the result of shortcomings in the system of planning instrument development, manufacturing and distribution, and particularly the lack of coordination with plans for developing standards and reference MI which in the end determine the level of measuring technology used in the national economy.

It was stressed that in order to eliminate these shortcomings it would be feasible to specify as a mandatory stage the development of control means during the development and manufacturing of new equipment and technology. It was also noted that problems of metrological support had not been properly covered in the Provisions for the Procedure of Forming Unionwide S&T Programs.

Conference participants adopted comprehensive recommendations aimed at solving the above problems and overcoming difficulties in the area of metrological support of manufacturing high-quality machine building products.

In particular, the recommendations deemed necessary to do the following:

provide in metrological support programs for the development and implementation of special automated instrumentation equipment, including equipment incorporated into manufacturing processes, as well as equipment for stand processing of products;

accelerate development and industrial implementation of means for metrological support necessary for the as rapid as possible implementation of state-of-the-art manufacturing processes in the machine building industry, including processes that use FMS and RC, three-coordinate measuring machines, precision and superprecision machine tools, processes for making superfine-finish surfaces and products made of composite materials, powder metallurgy products and instruments used for technical diagnostics;

when developing measurement systems and instruments for use in FMS and RC, provide the capability of direct computer connection thereof, and for systems and MI incorporated into automated machines, FMS and RC provide the capability of metrological control during operation without disassembling;

expand development and manufacturing of automated calibration machines for the most widely used MI, based on type-and-size series of unified assembly units (hardware and software modules);

organize development and series production of means for automated control of parameters of parts in the connecting rod-piston group, tooth measuring instruments, roundness gauges and roughness indicators, as well as means for controlling parameters of large bearings;

organize production of the entire nomenclature of reference roughness gauges for checking profilographs and roughness indicators, and roughness comparison specimens that are needed for product quality control at machine building enterprises;

over a short period of time considerably expand production of measuring instruments and means for calibration of mass production instruments for measuring geometric parameters (sets of end standards of the meter, reference V-blocks, machinist's straight edges and squares, interferometers, surface tables, reference thread gauges etc.), as well as spare parts therefor;

expand series production of means for nondestructive testing of products of the machine building industry;

continue the work on improving the MI repair system, based on developing repair at specialized industry enterprises, and significantly increase production of spare parts for MI;

for Gosstandart SSSR institutes: organize studies of the technology of control operations at enterprises and associations, systematize and summarize industry experience under the State acceptance conditions, and on this

basis develop proposals on improving the work in the area of development and implementation of the most efficient control methods and means;

accelerate development of methodological documentation on assessment of measurement errors, development of the collection of time standards and fee schedules, as well as an interindustry document that regulates work performed by industry metrological departments for outside organizations, etc.

It is necessary to complete organization of centralized metrological services in machine building industries and improve efficiency of head and base organizations of respective services at institutes, associations, enterprises and organizations in conducting metrological examination of technical standards, design and manufacturing documentation, certification of control and testing instrumentation and diagnostic equipment, and measurement, test and control methods.

Special atention was paid to developing works related to assessment of indicators of measurement and test accuracy, validity of control results, setting standards for MI accuracy indicators and measurement procedures, methods for metrological certification of test equipment, standard specimen certification etc.

Conference participants deemed it feasible to conduct annual coordination-methodological meetings with representatives of metrological services and regularly inform head organizations on regulation materials and documents in the metrological support field.

Recommendations noted the need to create a single center that would coordinate all work on economic problems of metrological support.

It was recommended that the Coordination Council on Metrology and Instrument Making of Gosstandart SSSR NTS [S&T Council] work more actively on solving the most important problems of developing and improving metrological support of machine building sectors of the national economy and increase involvement of representatives of interested Ministries and agencies.

Captions

International Show "Svyaz" [Communications]: Section "Measurement of Parameters of Semiconductor Devices and Integrated Circuits", prepared by Gosstandart SSSR

Combined Device F-4372 With Digital and Electron-Beam Indication. Designed for measuring d.c. and a.c. current, resistance, frequency of electric signals etc.

Optical Oil Film Thickness Gauge. Helps control the level of water surface pollution. Measurement range from 10 micrometers to 10 mm.

Measurement Amplifier-Converter UPI-2. Designed for amplification, conversion and filtering of the input voltage of a signal and for coordinating it with outputs of measuring devices. Operating range from 2 Hz to 100 kHz

12770

"Machine Building for 70th Anniversary of Great October Revolution" Exhibition

18610418b Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 4, Apr 88 pp 28-34

[Article by T.V. Koftova, engineer, and Ye.T. Larina]

[Text] An international exhibition bearing this name opened on the eve of this momentous anniversary. Its purpose was to demonstrate domestic machine building's leading role in all spheres of the national economy, the dynamics of its development during the years of Soviet rule, and also its development prospects in the 12th Five-Year Plan period and for the period to the year 2000.

The machine building complex's leading role and its contribution to the implementation of the decisions of the 27th CPSU Congress and the subsequent plenums of the CPSU Central Committee were revealed especially convincingly at the exhibition.

Two thousand exhibits were distributed over 10 sections of the exposition and they acquainted visitors with samples of up-to-date production equipment by means of which the main problems of acceleration in the machine building complex itself must be solved, i.e., raising the technical level and quality of products, economizing on resources, increasing labor productivity and lowering the prime cost of products.

Samples of new equipment in various sectors of the national economy were demonstrated in the largest section of the exhibition, titled "New Kinds of Machine Building Products."

Unique machine tools, flexible machine system modules (GPMs), robotized production systems (RTKs), lines and equipment for hardening the surfaces of parts and applying coatings, measuring equipment and load handling and transport and warehouse equipment were presented in the section titled "Modernization of Machine Building Production."

The type OGPSK400 flexible machine system (GPS [FMS]) consisting of multipurpose NC machine tools is designed for the integrated machining in a totally automated cycle of complex body parts made of cast iron, steel, non-ferrous metals, light alloys and plastic measuring 400 x 400 x 400 mm and weighing up to 500 kg.

The FMS contains the following: Two to 10 multipurpose high-precision drilling-milling-boring machines featuring automated tool and workpiece changing. One to four storage units. A transport system for moving parts set up on satellites between machine tools and part storage units. Three to 14 manipulators for unloading. Twelve to 48 satellites. Cutting and auxiliary tools. The use of this FMS improves labor productivity by a factor of two to three.

A flexible machine section (GAU) for machining parts of the solid of revolution type serves the function of machining 59 types of parts 25 to 402 mm long, 24 to 95 mm in diameter and weighing 0.33 to 6.4 kg.

The section, measuring 48 x 18 m, works for three shifts with a minimum number of attending personnel.

A GAU having an annual schedule of 248,000 parts will be introduced at the Chekhov Power Plant Machine Building Plant. The expected saving is 576,000 rubles.

It was developed by the Atomkotlomash NPO [Scientific Production Association] (Rostov-na-Donu [Rostov on the Don]).

The model IRT 180 PMF4 RM flexible machine system module (GPM) executes the multipurpose machining in small- and medium-scale production of parts 200 mm in diameter and 165 mm long, of the solid of revolution type, made of ferrous and non-ferrous metals.

The GPM, which can operate automatically for a long time without the operator's participation, turns and cuts threads with thread cutters, drills holes, mills surfaces having a complex configuration and cuts threads with taps.

The module's overall dimensions (without the storage unit) are 4900 x 3570 x 1650 mm.

The saving is 73,000 rubles.

It was developed by the Ivanovo Machine Tool Building Association imeni the 50th Anniversary of the USSR.

A standard flexible transport module featuring automatic addressing transfers satellites together with the pieces to be assembled to the required work sites of flexible assembly lines.

The module, which measures 7300 x 1600 x 1100 mm and weighs 850 kg, consists of driving and pulling mechanisms, intermediate and transfer sections and satellite retention mechanisms. The module can be designed for a flexible assembly line of any size with an unlimited number of transport streams. The module's control system is a programmable controller based on an Elektronika-S521M microcomputer.

Its developer and manufacturer is the Sborochnyye mekhanizmy [Assembly Machinery] NPO.

Multipurpose machine tools and the model IS800 GPM execute the integrated machining of body parts made of ferrous and non-ferrous metals.

Holes 3 to 45 mm in diameter can be drilled, holes up to 315 mm in diameter can be bored, contour milling and grinding can be performed and screw cutting and milling can be performed on the GPM, which has satellite table dimensions of 800 x 800 mm.

The GPM performs the following auxiliary operations: Changing of tools and machined parts. Monitoring of dimensions of parts and tool breakage. Correction of measuring head placement error. Grinding wheel dressing. Monitoring of tool life and replacement of tools with duplicates. Monitoring of cutting conditions. Removing chips from the cutting zone and conveying them to a container. Cleaning abrasive materials from the cutting fluid.

The manufacturer is the Ivanovo SPO [Special Design Bureau] imeni the 50th Anniversary of the USSR.

The model OP24 B automatic balancing line, measuring 3655 x 4000 x 2700 mm and weighing 4500 kg, serves the function of the running balancing of rotors 280 to 455 mm long and weighing 3 to 10 kg for series AI and AIR motors with an axis of rotation height of 80, 90 and 100 mm.

The line consists of an adjusting machine, testing and measuring balancing machines, sorting and transport devices mounted on a common plate, and also loading and unloading storage units.

The line's productivity is 75 items an hour. The time it takes to readjust from one rotor size to another is 50 minutes.

The developer of the line is the Mikron PO [Production Association] and the SKB PS [Special Design Bureau for [not further identified]].

A robotized production line (RTL) for multi-operation cold sheet-metal stamping is designed for feeding flat blanks measuring 40 x 40 to 100 x 100 mm and 1.5 mm thick from the stack to the press's die, removing parts from the press and subsequently placing them in holders, transferring parts in the holder for the next operation, delivering parts from the holder to the gripping device of a type MP-9S industrial robot, and feeding and removing finished parts from the press's die.

The RTL consists of a pneumatic hopper with productivity of 60 items per minute, a chute measuring 1120 x 500 x 50 mm with a pneumatic shutoff device, devices for placing in holders, two industrial robots with aerodynamic gripping devices, a transport industrial robot, a gate feeder and two type KD 2326 presses.

The line's developer is the RostNIITM [not further identified] NPO.

An industrial robot of the Krab [Crab] type featuring energy recovery attends to press forging equipment and also automates the "take-and-place" operations.

The industrial robot, haing a load-lifting capacity of 0.63 kg and three degrees of mobility, has two drives—for horizontal movements (electromechanical) and for vertical (pneumatic).

Its overall dimensions are 700 x 300 x 400 mm and it weighs 40 kg.

The saving is 43,000 rubles.

The developer and manufacturer is PKTIkuzrobot [Planning and Design and Technological Institute of Forging Robots].

An industrial robot of the Geym type featuring energy recovery moves parts and raises and lowers them at the end locations in cold stamping shops with large-scale and quantity production.

The robot's load-lifting capacity is 2.5 kg. The working member's positioning accuracy is plus or minus 1.1 mm, the number of degrees of mobility is two, and the overall dimensions are 800 x 400 x 400 mm with a weight of 50 kg.

The approximate saving is 43,000 rubles.

The developers are IMASh AN SSSR [Institute of Machine Science, USSR Academy of Sciences] and PKTIkuzrobot.

An electron discharge machining GPM for profiling and broaching work machines shaped parts made of structural and other hard-to-machine steels and alloys. It can also be used for machining forging, bending and trimming dies, metal molds and molds for plastics, rubber and glass.

The module's machine tool measures 1740 x 1760 x 3100 mm and weighs 2.2 tons and is furnished with a planetary table with working surface dimensions of 630 x 400 mm, high-torque drives for three axes, adaptive control of the machining process, an NC unit, a magazine for 12 tool electrodes and an automatic tool changing device.

The maximum weight of the blank is 800 kg and the GPM's maximum productivity is 1200 cubic millimeters per minute.

The developer is ENIMS [Experimental Scientific Research Institute of Metal-Cutting Machine Tools].

The model 1716PF4RM2 multipurpose center-chuck GPM machines parts of the solid of revolution type (turning; finishing operations; milling flats, grooves and

slots; drilling center-mark and radial holes; thread cutting with one set-up of the blank) in an automatic cycle with the limited participation of attending personnel for two to three shifts.

The maximum dimensions of a part that can be machined are 160 mm in diameter by 500 mm and the range of outside diameters that can be measured automatically is 25 to 200 mm, and of inside 20 to 190 mm. The industrial robot's load-lifting capacity is 10.2 kg with one gripping device and 5.1 kg x 2 with two gripping devices. The area occupied by the module is 20 square meters and it weighs 5600 kg.

The model M1DYe3327.Ts1.01 flexible machine system module is designed for making articles by the injection molding method from thermoplastic materials, including polyolefins, polystyrene and its copolymers, polyamides, etc.

The GPM, measuring 3600 x 1600 x 2500 mm and weighing three tons, consists of a casting machine, a program control system, a manipulator for removing workpieces, a manipulator with a load-lifting capacity of 0.5 kg for transferring workpieces and removing gates, equipment for automatically changing mold inserts, equipment for lubricating the mold and for loading granular material into the machine's hopper, a conveyor for removing workpieces from the dropout zone, and clamps for mold units.

The developers are UkrNIISIP [Ukrainian Scientific Research Institute of Machine Tools, Tools and Instruments] and the Khmelnitskiy Termoplastavtomat PO imeni the 26th CPSU Congress.

The model DU711V08 robotic system (RTK) for casting makes it possible to produce a wide range of castings of aluminum and copper alloys with a complete processing cycle (including trimming and removing gates and flashes). It is possible to produce castings of magnesium and copper alloys by manual casting.

The system, measuring 6200 x 4200 x 2300 mm and weighing 1700 kg, performs the following production operations in the automatic mode: blasting, applying the parting agent to and closing the mold; measuring out, transporting and pouring the metal; extruding; removing the casting from the mold; moving the casting to the area of the trimming press; trimming the butt end, gates and flash in the trimming press; and removing the casting from the trimming press.

The system is controlled by a programmable controller.

The saving is 116,400 rubles.

The developer is the Special Design Bureau for Precision Casting Machines of the Tochlitmash [Precision Casting Machines] MPO [International Organization].

An RTK with productivity of 1000 items an hour for forming ZIL motor vehicle parts makes it possible to automate the forming process in small- and medium-scale production.

The RTK, measuring 1200 x 1000 x 1000 mm and weighing 200 kg, is distinguished by its ability to group gate feeding and a manipulator with a single storage and orienting unit.

The use of this RTK increases the production equipment's utilization factor and its operating efficiency.

The developer and manufacturer is the Moscow Motor Vehicle Plant imeni I.A. Likhachev.

The MPRM 100-060 rotary line for compacting with a force of not greater than 100 kN mono- and bimetallic silver-containing contacts is used in powder metallurgy.

The line is made up of the following: a 9-position revolving table for compacting with a drive, power unit, lubrication system, mechanisms for dispensing the mixture and substrate, a vacuum cleaner, a device for removing compacts, a hopper and electrical equipment.

The number of press strokes per minute is 50, 90 and 110. The maximum size of an article that can be compacted is 26 mm wide. The line's overall dimensions are 1365 x 1185 x 2475 mm and it weighs 3000 kg.

The developer is VNIITelektromash [All-Union Scientific Research and Planning and Design Institute of Electrical Machine Building Technology] (Kharkov).

The LKRTs-PR15-2 automatic rotary conveyor line, measuring 1520 x 1100 x 2230 mm and weighing 4000 kg, sizes the rollers and bushings of power transmission chains, thus ensuring the high quality of these parts on account of the precise execution of their outside diameters.

The presence of an extra (second) master cam in the revolving feed table ensures a high percentage of parts falling into the pockets of the conveyor chain.

The line's introduction improves productivity by a factor of four, frees 232 people and reduces the production space by 1047 square meters.

The saving is 444,000 rubles.

The manufacturer is the Daugavpils Power Transmission Chain Plant.

A robotic system (RTK) for the plasma-arc treatment of materials performs the air- and plasma-arc cutting of complex bulky metal structures and flash trimming of stamped structures, the cutting out of windows of various configurations in tubes, and also the plasma-arc welding of complex structures made of aluminum alloys,

stainless steel, copper and other materials. The RTK includes an industrial robot and two manipulators for securing and positioning parts, a model UPS-301 plasma-arc cutting unit and two plasma generators.

The maximum extension of the arm in the horizontal plane is 900 mm and the robot's base rotates 260 degrees. Positioning accuracy is plus or minus 0.1 mm and the load-lifting capacity of the robot's arm is 10 kg. The thickness of materials that can be cut is 5 to 30 mm and of those that can be welded 0.5 to 8 mm.

The developer is VNIIESO [All-Union Scientific Research, Planning and Design and Techological Institute of Electric Welding Equipment], Leningrad.

The model M 380 line for the plasma-arc cutting of rectangular tubes having cross sections of 80 x 80 to 250 x 250 mm, a length of 4500 to 12,500 mm and wall thickness of 5 to 12 mm can operate independently or as part of systems for producing frame structures in the motor vehicle, tractor and agricultural machine building and other branches of industry.

The plasma-arc cutting unit, measuring 23,800 x 5200 x 1860 mm and weighing 19,000 kg, including a rotary table with a drive and a carriage with a plasma generator, moves the plasma generator around the tube according to a program and makes possible specific technological parameters for the process.

The weight of tubes that can be loaded onto it is 10 tons. The length of stock that can be cut is 800 to 900 mm. The precision of the cutting of stock is plus or minus 1 mm. The time for a single cut is 8 to 20 s.

The developer is the ANITIM [Altai Scientific Research Institute of Machine Building Technology] NPO.

A unit for the micro-plasma-arc cutting of tubes 60 to 140 mm in diameter and rectangular tubes with a maximum side dimension of 60 to 120 mm and a wall thickness of up to 10 mm, made of low-carbon and corrosion-resistant steel, non-ferrous metals and their alloys, consists of a feeding roller conveyor, a machine tool for air-arc and plasma-arc cutting and a control cabinet.

The unit's overall dimensions are 600 x 1000 x 700 mm. The introduction of the unit increases cutting productivity by a factor of two to four as compared with gas-arc and oxygen cutting and mechanical cutting.

The model FGS-70 ferrohydrostatic separator separates according to density with high precision in a ferromagnetic liquid cable scrap and home electronic equipment scrap into products that can be used for producing metals and alloys according to specification.

The operating principle of the separator, which measures 1025 x 730 x 1760 mm and weighs not more than 2100 kg, is based on the use of the buoyant force originating in a ferromagnetic liquid in interaction with an external nonuniform magnetic field. The separator consists of an electromagnet with pole pieces, a loading compartment and a vat containing the ferromagnetic liquid.

Its productivity is up to 2000 kg/h. The size of the starting product that can be separated is 25 mm.

A debarking machine is designed for debarking logs 100 to 550 mm in diameter and 2700 to 7500 mm long and hardwoods. A self-centering conveyor is set up for feeding logs into the machine.

The productivity of the machine, which measures 9800 x 2307 x 2565 mm and weighs 12,500 kg, is up to 200 cubic meters per meter of logs per shift.

Its developer is GKBD [not further identified], Vologda.

Welding stations based on model 161/60 and 601/60 industrial robots having a load-lifting capacity of 60 kg with six degrees of freedom for the spot welding of bodies and front ends in the assembly of automobiles automate the operations of finishing the body of the VAZ-1111 automobile and the front end in assembly and the body of the VAZ-2108 automobile.

The station consists of an industrial robot with welding equipment and a platform for fastening the robot and locating and securing the piece to be welded. The positioning accuracy of the PR161/60 is plus or minus 0.5 mm and of the PR601/60 plus or minus 1.2 mm.

The developer and manufacturer is the AvtoVAZ [Volga Motor Vehicle Plant] PO.

Equipment for Resistance Welding

The MTP-1110 overhead machine performs the resistance spot welding transversely of low-carbon-steel sheet blanks and reinforcing bars. The machine's drive is pneumatic. The machine is outfitted with two kind of tongs: the KTP-8-1 having electrodes that run radially (compressive force of 250 DKN) and the KTP-8-2 having electrodes that run at right angles (compressive force of 320 DKN).

The machine's productivity in welding parts 0.8 + 0.8 mm thick is 145 welds per minute. Its overall dimensions are: main unit—720 x 730 x 880 mm; KTP-8-1 tongs—510 x 350 x 302 mm; KTP-8-2 tongs—590 x 350 x 280 mm. It weighs 341 kg.

The K-747MV (UKD-101) unit is designed for the capacitor stored-energy welding of smooth shafts 2 to 10 mm in diameter and 15 to 100 mm long, with or without

a gas shield, (with a maximum distance from the power supply of 30 m), to sheet pieces not less than 0.5 mm thick, made of ferrous and non-ferrous metals and alloys.

The maximum discharge rate (productivity) is six pulses per minute. The unit's overall dimensions (without the gun) are 750 x 550 x 1100 mm and it weighs 110 kg.

The K-700-1.01 (USO-40001) unit performs the continuous-flash resistance welding of individual insulated or uninsulated pipes or pipe sections up to 36 m long and 1420 mm in diameter into a continuous pipeline. [Words missing] section 12 m long) six butt joints per hour. The unit's length is 1047 mm, its diameter is 1400 mm and it weighs 51,880 kg.

The manufacturer is the Pskov Heavy Electric Welding Equipment Plant.

Lines and units for hardening the surfaces of parts and applying coatings were widely represented at the exhibition and light was shed on work on the mastery of new technologies.

The plasma-jet hard-facing of an antifriction layer 2 to 6 mm thick and 10 to 50 mm wide onto hydraulic cylinder pistons is accomplished by means of a direct-action plasma arc with the filler wire fed into it laterally at an angle to the piece's surface. The process makes possible high productivity (up to 15 kg/h of the faced layer) as compared with oxyacetylene facing or facing with piece electrodes and it improves the quality of the faced layer. The diameter of solids of revolution that can be faced is greater than 60 mm.

The expected saving is 5000 rubles.

The manufacturer is the RostNIITM NPO.

An air-gas plasma generator with 1000 kW of power and a unit for the gas-flame flashing of facings are used for hardening drilling equipment parts. Self-fluxing nickel alloys, alloy powders and high-melting compounds are used as facings. These facings extend the service life of parts by a factor of three to five as compared with quantity-produced parts hardened by TVCh [high-frequency current]. The deposition productivity is 25 kg/h. The equipment installed in the section makes it possible to treat parts up to 1500 mm long and up to 300 mm in diameter and weighing up to 150 kg.

The Plazma-403 high-frequency unit with 96 kW of power is designed for treating metalworking tools and stamping equipment in an induction plasma under atmospheric pressure for the purpose of hardening them. The unit weighs 3000 kg and consists of a generator unit, a process unit and two control units and is furnished with an NC unit.

The unit's productivity is 60 square centimeters per minute. The deposition time is 20 to 60 s.

The developer is VNIITVCh [All-Union Scientific Research Institute of High-Frequency Current imeni V.P. Vologdin], Leningrad.

The model 3201P semiautomatic NC unit for deposition by spraying serves the function of depositing single- and two-component powder materials onto the outside surfaces of cylindrical parts up to 1600 mm long and up to 500 mm in diameter and weighing up to 500 kg and of parts having a complex configuration by the plasma-jet spraying method for the purpose of imparting to them various properties (wear resistance, corrosion resistance, etc.), as well as for restoring worn surfaces of parts.

The semiautomatic unit, measuring 4850 x 4850 x 2450 mm, is a unit of the chamber type with sliding doors.

The rate at which the plasma generator moves along a part's axis is 0.16 to 140 mm/s and 1.1 to 50 mm/s perpendicular to the part's axis. The power requirement is not greater than 110 kW.

The developer is the VISP [All-Union Institute of Welding Production] NPO, Kiev.

The Pluton-1 LN-1, 2NO-I1 laser process unit is designed for the surface hardening, alloying and cladding of machine parts (gears, feed screws, crankshafts, etc.). It is used in the car-and-tractor, machine tool and tool and other branches of industry.

The part's surface is heated by a focused laser beam. The rate movement of parts relative to the beam is up to 10 m/min.

The wavelength is 10.6 micrometers and the beam diameter is 50 mm (outside) and 30 mm (inside). The overall dimensions of the laser are 2100 x 1800 x 2070 mm and it weighs three tons.

The laser heat treatment of parts improves their wear resistance by a factor of two to five.

The NNV-6,6-I2 unit for depositing wear-resistant coatings serves the function of hardening metalworking tools up to 200 mm in diameter and up to 250 mm long by the method of vacuum condensation of a material and ion bombardment. The unit, measuring 3400 x 3600 x 2170 mm and weighing 4200 kg, is furnished with a microprocessor system for controlling the production process and makes possible high productivity and a high-quality coating. The length of the working chamber is 600 mm and its diameter is 600 mm. There are three electric-arc evaporators. The deposition rate for coatings (titanium nitride) is 5 to 40 micrometers per hour.

The model G19-80 spark alloying unit is designed for hardening cutting and stamping tools and production equipment, as well as for improving the wear resistance and restoring the dimensions of machine parts.

The unit, which measures 401 x 230 x 214 mm and weighs 14.5 kg, consists of a surge current generator and a hand electromagnetic vibrator. Covering with a hard alloy and other wear resistant composites 7 to 30 mm thick with surface roughness of 3 to 6 micrometers increases the service life of tools and production equipment by a factor of two and more.

Its productivity is up to three square centimeters per minute. The saving is 10,000 to 12,000 rubles.

The developer and manufacturer is the Spetstekhosnastka NPO.

An automatic line for chrome-plating hydraulic cylinder rods 63 mm in diameter and up to 1000 mm long in a stream of electrolytes and in the automatic mode.

The line, which measures 6365 x 2060 x 1925 mm and weighs 15.3 tons, eliminates manual operations in the assembly of equipment and the loading (unloading) of parts. The line's productivity (with a chromium layer thickness of 24 micrometers) is 60,000 to 85,000 rods a year.

The introduction of the line made it possible to save 650 kWh of electric power, to reduce water consumption by a factor of 4.85, to free 170 square meters of production space and to gain a saving of 155,000 rubles.

The developer is the VPTIstroydormash [All-Union Design and Technology Institute of Construction and Road Machine Building] NPO.

A unit for applying a protective material is designed for applying a protective layer of a silicone compound which is squeezed out onto the surface by compressed air.

Its productivity is 200 items per hour. The saving is 5000 rubles.

The developer and manufacturer is VEI [All-Union Electrical Engineering Institute] imeni V.I. Lenin.

The hardening of the working surfaces of parts by means of a tungsten-less composite alloy makes it possible to improve the wear resistance of parts functioning under conditions of abrasive-gas and abrasive wear and to extend their service life by a factor of three to eight as compared with parts faced with an alloy of the sormite type, and to save scarce tungsten. The tungsten-less hard component of the composite alloy, which possesses enhanced hardness, receives the main impact loads, and the binder alloy distributes them uniformly over the entire bulk of the facing. Carbides and nitrides of metals are used as the hard component.

Laser hardening is used for low-rigidity steel and cast iron parts, parts having a complex shape that require local hardening, and also for important parts of machine tools which it is impossible to harden by traditional methods.

The laser hardening process was introduced at the Krasnyy Proletariy [Red Proletariat] MSPO [International Specialized Production Association]. The plan is to subject to laser hardening in 1990 up to 4000 parts per year with an expected saving of 1.8 million rubles.

The experience of leading machine building enterprises in activating the human factor under conditions of perestroika [restructuring], of changing to economic methods of management and of introducing the achievements of scientific and technical progress was summarized in the "Improvement of Production Organization," "Solution of Social Problems" and "Personnel Securing" sections.

Everything that has been accumulated in the theory and practice of management under conditions of total cost accounting was presented in the "Improvement of Forms of Production Organization in Machine Building" section. The section's display emphasized the fact that the organization of machine building production at today's level is based on the achievements of science and management.

The exhibits of VNIPI OASU [All-Union Scientific Research and Planning Institute of Sectorial Automated Management Systems] of Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems] displayed the idea of developing an integrated system for the management of machine building production based on the achievements of science and automation engineering.

The conversion of enterprises and associations to self-financing is being made possible by the development of cost accounting and strengthening of the responsibility of labor collectives for the end results of their work. This was confirmed by the interesting work experience, presented at the exhibition, of enterprises such as the Sumy Scientific Production Machine Building Association imeni M.V. Frunze and others.

The experience of the conversion of an entire industry to cost accounting was revealed by using Minavtoprom [Ministry of the Motor Vehicle Industry] as an example. Much of this experience can be used by other machine building industries too.

Much attention was paid in the section to the development of the brigade form of work organization and of intraindustry cost accounting.

Machine building enterprise quality control systems based on state standards with long-range technical specifications, a program for the unification of products and

production specialization, the introduction of function-cost analysis, the enactment of a state acceptance system, etc., were presented in the display.

Full-scale models acquainted visitors with facilities for the automation of management work at various levels. These included automated workstations for an enterprise manager, designer, industrial engineer, operator, foreman, etc.

Management systems in operation in various areas of the machine building complex were demonstrated.

The processes of planning, operations management, the servicing of work places with blanks, process control and the removal of chips from work places and a section as a whole have been automated with the introduction of an automated machining system (ATK MO) for parts of the solid of revolution type in crane production.

The ATK MO is furnished with an automated control system for production processes employing a UVK-SM-1 No 4 control computer, workstation consoles, service panels, teleprinters, a machining department containing 10 NC machine tools, an automated transport and warehouse system (ATSS) using a piler crane, and 13 PUM-250 manipulators. The annual schedule calls for the manufacture of 50,000 parts of 47 types with the system working in two shifts. With its introduction the equivalent of 52 people will be released, labor productivity will increase by a factor of 1.8 to 2, and the equipment utilization factor will equal 0.85 to 0.9.

A model plan for the organization of work, production and control for machining sections is being used as guideline material in the development of working plans for the improvement of work organization in machining sections and for the certification of machine tool operators' work places.

The plan can be used at enterprises of all branches of the machine building industry with a single-unit and small-scale type of production. A work organization chart for work places has been developed for 23 kinds of trades. The saving has been 81,000 rubles.

The ASU [automated management system] of the Rostselmash Production Association includes five ASUs for three levels of management: the first for the association (ASU-Association), the second for enterprises included in the association (ASU-Plant, ASU-Tools), and the third for production processes included in the Rostselmash PO (ASU-Production Processes). A distinctive feature of the system and its main design principle is the intercoordinated development of all systems taking into account the sufficient independence of each one. The ASU-Plant is the central system in the ASU system of the Rostselmash PO. A characteristic feature is that its functioning takes place in real time and with the provision of a query-response mode concerning the course of a production process. All data arriving from data collection points are computer processed and recorded in a database. This makes it possible to obtain information concerning the course of a production process part by part at any time. Thus, recordkeeping is conducted by means of a computer in real time beginning with the arrival of materials at the plant and ending with the shipment of products.

An interactive automated system for the efficient layout of shaped blanks on a sheet and for the designing of control programs for plasma-arc cutting for units of the Kristall [Crystal] type is designed for automation of the design process by using an Iskra-226 microcomputer. A distinctive feature of it is the use of a microcomputer in the interactive mode. The system is written in the Skoropis [Speedwriting] language and operates under control of the Skoropis operating system. The saving from introduction of the system is 24,000 rubles. The saving of metal is 152 tons and four process engineers have been released.

An automated process control system, demonstrated at the exhibition, for accelerated service-life stand tests of agricultural machines (the Service Life ASUTP) is used for making stand tests of metal structures of agricultural machines and other equipment. The following functions are implemented in the ASUTP: immediate measurement, monitoring and display of process parameters and indicators of the condition of the equipment; manual entry of initial data and automatic formation of the loading process; swapping of data between management levels; calibration of control and measuring channels; immediate display of the course of the testing process and the output of test protocols. The system can be used at various machine building enterprises and in organizations conducting service-life stand tests of metal structures.

A standard system for accounting for commodity stocks in real time improves the efficiency of practical management of the production operations of an enterprise by the organization on the basis of computer facilities of reliable monitoring of the manufacture of products and of accounting for them according to process changes in real time, as well as by the disclosure and reduction of losses of physical resources in the production process. The system's database is comprised of a set of local direct-access files formed on the basis of combined production specifications and containing information on the route for the processing of materials and parts; norms for uncompleted production back-logs in shops and stock in warehouses; the level of the use of metal, parts and assembly units in products; prices; norms for parts; production schedules; etc. The system has been introduced at the frame extrusion plant of the KamAZ [Kama Motor Vehicle Plant] PO. Its implementation improves the even pace of production and improves the quality and efficiency of management because of the more complete and reliable gathering of information. The saving from its introduction is 200,000 rubles.

The SLK SM local area network station is designed for constructing a multiuser computer system consisting of terminals and a computer and is recommended for use in instrument making and computer engineering. The stations are connected into a ring and there can be up to 125 users in a single ring.

The series B7/B9 (MSUVT) control computer equipment microfacilities presented at the exhibition are a set of design hardware and system modules and software products based on microprocessing structures and are designed for the development of automated systems for controlling equipment and production processes and automated testing systems. The extensive use of large-scale integrated circuits increased the capabilities of the MSUVT and made it possible to place an entire control microcomputer on a single printed circuit board in a single unit—a system having a set of printed circuit board assemblies for communicating with the controlled system. Several systems (microsystems) controlling the operation or testing of a complex system can be united into a unified multilevel distributed microprocessing system (a micronetwork).

A data gathering system for YeS [Unified Series] computers (the SSD/YeS) makes it possible to perform the following functions: the input of data through switched and dedicated telephone and telegraph communication lines, as well as from any local terminal; checking of data and transmission of diagnostic messages to users; interactive correction of data; loading of data into random-access databases both interactively and by batch processing; checking of the completeness of data.

An experiment in the commercial use of the SSD/YeS demonstrated that it can be used effectively as part of an integrated data processing system.

The ASOU [automated organizational management system] RD [not further identified], demonstrated at the exhibition, is designed for automation of the process of planning and accounting for the operations of organizations.

The system makes it possible to form annual plans for subdivisions, taking into account their interaction in working on a shared topic, as well as for resources allocated for jobs. Monthly planning and accounting are performed and changes are introduced into plans on the basis of annual plans. The system consists of a set of interactive queries making it possible to enter data into a database and to obtain information concerning the status of jobs. A set of packaged software makes it possible to print out plans (reports). The system operates on a YeS computer having a main memory of not less than 2 MB. It provides the following functions: recording of jobs by topic; breaking jobs up into smaller units based on standards; assignment of performers and deadlines; balancing of labor intensiveness; correction of data with recording of "was-became"; input of values of resources consumed and formation of reports. The saving from introduction of the system is 9300 rubles.

A system for the automatic sending of telegrams for YeS computers (the SART) is being used for work in large administrative management systems. The SART does not have qualitative analogues among YeS computer software. All of the SART's functions are performed dynamically with continuous functioning of the teleprocessing system. The experience of the introduction and commercial use of the SART has demonstrated that it makes it possible to lower costs substantially and to speed up the sending of telegrams.

The Pricing Control automated system (AS), which can be used as part of the OASU [sectorial automated management system] for branches of the machine building industry, attracted the visitors' attention. The AS functions with the use of the Prices database. Information is presented to the industry's enterprises in unified form and is entered into a database where automated checking and correction are performed. The AS frees specialists from the routine job of processing statistical data on prices, makes it possible to make an analysis of combined indicators and improves the grounds for making management decisions.

A relational database management system, presented at the exhibition, for professional personal computers, and that can be used as part of ASUs [automated control systems], SAPRs [computer-aided design systems], IPSs [information retrieval systems] and ARMs [automated workstations] for various purposes, is quite interesting. Its purpose is automated individual paperwork. The system's users are specialists in scientific and technical, industrial and non-industrial fields, administrative personnel and office workers of various categories and applicationsprogrammers.

The following are the system's main functions: description and creation of database (BD) files; input, correction and editing of data; copying, display on screen and printing of data; rapid retrieval of data according to assigned conditions (queries); rapid sorting and indexing of database files according to composite keys; generation and printing of reports; etc. Batch processing implements complex and multiply repeated data processing processes.

The FN typesetting and correcting unit, which is a special-purpose unit designed for proofreading, is also interesting, among other things. The unit can be used both as part of an automated publishing system (ASPTI) and independently as part of hardware for the preparation of photoforms. When the unit operates independently the text is written onto a magnetic disk, and when it operates as part of an ASPTI the text is also entered into the system's database. Each disk contains a catalog, i.e., a list of texts with an indication of their size.

The text and service information are displayed on the screen when typesetting and correcting. The service information contains the name of the text, its printing data and the operating mode. Control programs and data on the type of the text that is to be corrected are input from magnetic disks. The unit is furnished with a software package.

The experience of the Kostroma SPO can serve as an example of the introduction, presented at the exhibition, of brigade forms of work organization under conditions of the system of intraproduction planning and practical production management. The position "Intraproduction Planning and Practical Management of Key Production at the Kostroma ZDS [Woodworking Machine Tool Plant]" has been developed and introduced at the plant, based on the results of the plant's testing of a standard procedure of GPTIdrevstankoprom [planning and technology institute of the woodworking machine tool industry, not further identified]. The use of this procedure at the plant has demonstrated that in addition to the practical saving gained there is also an annual saving, since the performers utilize all the advantages inherent in the new production management system. Thus, the use of the procedure makes it possible to create the conditions for the introduction of cost accounting in shops.

The Kostroma ZDS is the first plant to have introduced a system for managing key production. The brigade form of the organization of work and the system of intraplant operations planning made it possible to change to full planning with payment for the end result of work, to improve labor productivity and product quality, to shorten the production cycle for the manufacture of products and to ensure the even-pace work of subdivisions. In addition, this made it possible to ensure the fulfillment of plan quotas with a smaller number of workers, to attract collectives to production management, and to increase the responsibility and interest of each worker in the results of the work of the entire collective.

A set of longterm planning tasks was demonstrated at the exhibition. The purpose of this set of tasks is to automate the process of the coordination with USSR Gosplan and the distribution by enterprise of the raw data and quotas for the development of five-year plans. Machine building branches of industry constitute the set's of tasks area of application. Its advantages consist in the ability to produce a strictly balanced plan meeting in the necessary aspects the conditions of full cost accounting and taking into account the introduction of the achievements of scientific and technical progress. The database for the initial information for purposes of longterm planning (the IIPP) provides high-speed access to information, compatibility with other software products, the convenient presentation of data, simplicity of maintenance and the ability to be used by non-professionals. The set's of tasks mathematical economic models are implemented on YeS computers and function by batch processing.

Automated workstations (ARMs) were presented at the exhibition, including one for a machine shop foreman, which is part of an automated shop management system and makes possible interaction between the user—the foreman—and the system in the process of the practical management of production.

The ARM makes it possible for the user to perform the following functions: the entry of operating data into the system; the obtaining of information and the modeling of a 24-hour-shift assignment (SSZ); and the entry of data from experts. The user interface is designed for two principal operating modes: control interaction using the menu technique, and working with machine-manual documents. The user interface is implemented in the form of independent input/output from an IVA ARM.

A brigade leader's automated workstation based on an ISKRA-1030 is designed for providing a brigade leader with up-to-date methods and facilities for the personal use of computer equipment for the purpose of the rapid and high-quality solution of problems relating to the practical management of a brigade. The ARM makes it possible to reduce unproductive equipment idle time and losses of work time relating to organization problems, and to improve the even pace of production, and this in turn will increase the amount of products produced without increasing the number of workers.

An automated workstation for design preparation for production is intended for enterprises involved in the development of design documentation for new products with the subsequent transmission of documents to manufacturing enterprises. It performs the following functions: the filling in and entry into a computer archive of design specifications; the development and writing of specifications according to an analog; the introduction of changes in design documentation. The hardware used in the system is an SM-4, SM-1420 or SM-1600 computer, a Videoton video terminal or a YeS-7209, and 128K of main memory.

The experience of the development of a continuous system for training, improving the skills of and retraining personnel at all levels was displayed in the section of the exhibition titled "Personnel Securing in Machine Building."

A great deal of work is being done on the occupational training of personnel directly at enterprises and in organizations of the machine building industry. The basic directions of the personnel policy responding to the tasks of perestroika and of the hastening of scientific and technical progress in machine building were reflected in this section.

The Kursor microprocessing teaching unit, designed for doing practical work relating to automation based on computer facilities and the program control of machine

tools and manipulators, as well as for solving a wide range of engineering and scientific and technical problems, is interesting in this section.

The experience of a whole series of machine building enterprises relating to further development of the social sphere was demonstrated extensively in the display of the "Solution of Social Problems" section. The in-operation Dining Hall ASU, which ensures high-productivity service at minimum cost, was of interest in this section.

The contribution of machine building ministries to increasing the production and improving the quality and expanding the range of consumer goods enjoyed the visitors' special attention.

8831

New Machine Building Industry Products Examined

18610176a Moscow STANDARTY I KACHESTVO in Russian No 3, Mar 88 pp 99-104

[Article by Yu. Simonov "Press Conference: Information for Thought (At 'Mashinostroyeniye-88' Show)" under the "Meetings, Seminars, Shows" rubric]

[Text] Almost 460 machine tools, 47 robots, 3 or 4 sets of flexible automated and semiautomated lines, 1,630 tractors. According to the largest show of the year, now at the VDNKh SSSR [USSR Exhibition of Achievements in National Economy], this is one day in today's life of the country's machine builders. Among the exhibitors are about 1,000 associations, enterprises and organizations from 34 Ministries and agencies (including Gosstandart SSSR [USSR State Committee for Standards]). They are demonstrating 2,140 items, which take up an area of over 30,000 m^2.

The show is non-traditional: it presents the latest achievements of Ministries-exhibitors, whether or not they belong to the machine building complex. Besides, unlike exhibits conducted earlier, this one illustrates three main directions in machine builders' activity: development of modern technology, machine building industry transition to new forms of economic management and, finally, the role of the human factor in modern production.

The show also has another feature: its organizers intentionally decided to show the public unique equipment, machines and instruments of which only one or two pieces have been made so far. This is why one can often see at the show such captions as "World's First" and "No Analogs". Among these are, for instance, an energy-intensive combine (module) "Polesye-250", which has to work year-round with a large number of trailing and mounted implements, or a 25 m long freight platform-trailer with pneumatic tires, which can haul a one- or two-story house.

However, one can ask a good question: "Will these original items remain just show exhibits? Will they wander from one show to another, as has been the case yestyear?" This first of all pertains to consumer goods, especially to complex home appliances.

As the 1987 was coming to an end, a press-conference for Soviet journalists was held at the Show on the initiative of the VDNKh press-center. At the opening, GKNT [USSR State Committee for Science and Technology] Deputy Chairman A.F. Kamenev spoke to the reporters. He characterized the Show essence and objectives. Then, numerous questions asked by reporters, including STANDARTY I KACHESTVO, were answered by management personnel of various industries (Deputy Ministers L.P. Safronkov (Minelektrotekhprom [USSR Ministry of Electrical Equipment Industry]), G.I. Kavalerov (Minpribor [USSR Ministry of Instrument Making, Automation Equipment and Control Systems]), A.M. Skrebtsov (Minselkhozmash [USSR Ministry of Traqctor and Agricultural Machine Building]), I.P. Solovyov (Minlegpishchemash [USSR Ministry of Machine Building for Light and Food Industry and Household]) and V.P. Morozov (Minavtoprom [USSR Ministry of Automotive Industry]); Heads of Main Technical Administrations V.N. Yefimov (Minstankoprom [USSR Ministry of Machine Tool and Tool Bulidng Industry]) and V.T. Shaturov (Minenergotyazhmash [USSR Ministry of Power Machine Building]); and Deputy Head of Main Technical Administration, Minstroydormash [USSR Ministry of Construction, Road and Municipal Machine Building] G.S. Andreyev.

Reporter. The harvest that has been completed the other day has revealed, for instance in the Moscow region, an acute shortage of reliable and efficient "all-weather" equipment. What is being done to correct the existing situation?

A.M. Skrebtsov. Implementation of an earlier approved system of machines has begun in the industry. I must admit, however, that we are still behind requirements of the times. Hence our main problem is to expand the nomenclature of manufactured agricultural equipment, and first of all equipment that can operate under extreme weather conditions, such as those that have developed during the most recent harvesting campaign. A so-called integrated tractor, built using the unitized-modular principle, could be of great help to agriculture workers. At present, the tractor is being developed by several design bureaus. There are first promising results.

In any case, by the end of the current Five-Year Plan the industry must master several hundred new machines. Some of them are presented at the Show.

What I would like to add is that our professionals have found out that a sort of "information hunger" still exists: often agriculture workers do not know of machines we make, while we in turn are not well informed of their needs and demand. Thus, the agricultural equipment Fair that was held in 1987 for the first time had demonstrated that control numbers given by planning bodies are not supported by actual purchases: some machines were in short supply while there were surpluses of others.There is an urgent need to reorient the industry toward its customer (a kolkhoz and sovkhoz) rather than its middleman (agroprom [agricultural committee]). Only then all "white spots" will be closed.

Reporter. Recently, a lot has been said and written (both good and bad things) about "Don-1500". Practice of the Volgograd and Tselinograd oblasts has demonstrated that these combines had more downtime than uptime...

A.M. Skrebtsov. I must say that the last year's difficult harvest time had virtually justified the hope we had placed in these combines: they had proven all parameters that have been incorporated in them. True, there are complaints regarding their reliability. They are mostly related to low quality of rubber components. But we are working hard on this with Ministries-suppliers. Incidentally, the program of integrated standardization of the "Don-1500" which has been approved recently by Gosstandart is helping us in this.

As to the regions you mentioned, "Don-1500" has not been designed for use there. One should not put high-efficiency machines which can harvest 40, 60 or even 70 centneres per hectare to regions where average crop yield does not exceed 16-18, and sometimes even 12-13 centners per hectare, as has been done in recent years. I am sorry, but this is great nonsense.

Reporter. State product acceptance. Statements on its role in solving the quality problem are made mainly by the service management or, even more often, by press people prompted by State inspectors. And what do Ministries' managers have to say? Does State acceptance help their industries? What are the relations between the State acceptance and production like?

V.P. Morozov. I can tell you: whereas during the first quarter of 1987 not more than 70% of products were accepted by State inspectors at the first presentation, as "grinding in" was going on and ways of working cooperation were being sought, today this index exceeds 85%, i.e. State acceptance has favorably affected both labor and product quality. We are therefore introducing extraagency control at 28 more plants.

My answer to the second question is this: when State acceptance and enterprise management have organized systematic and engineeringly competent work on quality, there are no problems. And vice versa, when State acceptance preaches an "Accept - Reject" principle and production workers are trying to bypass the system, problems do exist. But we are solving them with the help of professionals of Gosstandart SSSR.

Reporter. Could you give examples of the positive effect State acceptance has on the quality of the industry's work?

V.P. Morozov. Probably some people in the audience remember a driver's statement (it was published in IZVESTIYA) that once outside the gates of automotive plants, a lot of drivers must spend hours to "finish" the vehicles, tightening screws and nuts.

But if one visits enterprises where State acceptance has been implemented, I am 99% sure that one would not encounter anything like that. Recently, I was a witness to a conversation between two drivers who came to receive vehicles and drive them home. A driver was saying to his colleague: "I don't understand what has happened to ZIL [Moscow Automotive Plant imeni I.A. Likhachev]: I am trying to tighten screws and nuts, but they are not turning anymore".

L.P. Safronkov. As a result of joint work of design and manufacturing engineers and State inspectors, the number of quality claims to electric locomotives built by PO "NEVZ" [production association "Novocherkasskiy elektrovozostroitelnyy zavod"] has decreased by almost 70%.

A.M. Skrebtsov. In the first place, I would cite as apositive example the work of State acceptance at the Minsk Tractor Plant. Here, the work is organized in the best possible way: some extraagency inspectors work on current production, whereas others, in cooperation with plant departments, develop quality improvement strategy for the future. This is what not just the industry but the entire country needs. I am sure this experience merits the widest dissemination.

I would like to use this occasion to say this. I have been working with Gosstandart SSSR for virtually my entire profesisonal life. And I think that at present it is an entirely different organization: there is less bureaucratic red tape and more sensible advice and business-like help. For instance, just the other day we examined an operational-tactical problem PKS [not further identified] "Traktory" [Tractors]. Among other things, we decided which State and industry standards must be introduced in order to further improve the technical level of our tractors.

Reporter. Our editorial office has received an article by the State acceptance manager at the Kuntsevo Needle and Clothing Accessories Manufacturing Plant (STANDARTY I KACHESTVO No 1, Jan 1988, pp 44-48). The article states that the plant management, with full support by the Ministry, is torpedoing State acceptance measures aimed at improving the product quality. How can you explain this?

I.P. Solovyov. The plant is the head enterprise of the"Mostochlegmash" association. It makes manufacturing jigs and fixtures, dies in particular, for the light, food, chemical and other industries. For a number of years, the Ministry in cooperation with ferrous and nonferrous metallurgy professionals have been working on improving the quality of strips and shapes used for making these products. Measures that have been scheduled are being fulfilled, and there are no grounds now to say that the plant is torpedoing them. Besides, complete mutual understanding has been achieved between the State acceptance and associacion management. And the work is conducted in close contact with Gosstandart SSSR, because there still are problems which cannot be solved by one Ministry and/or overnight.

Reporter. When State acceptance was introduced at the first 1,500 enterprises, a lot was said about a very poor set of instrumentation that State inspectors had at their disposal. A year has passed. Recently, our reporters toured country's enterprises and checked the situation in Tashkent, Kiev, Novosibirsk, Leningrad and other industrial centers. It turned out that virtually nothing had changed: a rule, a caliper or plain intuition are still main instruments. It is great if someone somewhere has an old micrometer. How does one plan to solve this problem after all?

V.N. Yefimov. Unfortunately, due to certain circumstances, including less stringent requirements to product quality, the instrumentation subindustry has not been developing as intensively as it should have been. But nowadays, after implementation of State acceptance, the machine tool building industry has enough instruments, although one of course cannot say that the entire national economy has been equipped with state-of-the-art instrumentation. This is the thing for the future, it cannot be done overnight. But I repeat: there is certain improvement. Thus, in addition to 1987 targets a R5 million worth product line of measuring instruments was developed at NPO [scientific production association] "VNIIIzmereniya" (Moscow), which has pooled together a group of plants; and the situation at the "Kalibr" plant and other Ministry enterprises has stabilized.

As to the long-term prospects, the determining development of the industry has been planned for 1988; as a result, we think that by the ned of the Five-Year Plan it will be possible to meet to a considerable extent the country's demand for state-of-the-art instrumentation.

G.I. Kavalerov. Indeed, not only the implementation of State acceptance has revealed cases of underestimating technical standards documentation, sloppiness and wheel-spinning, but also certain more deeply engrained technical problems, such as equipment of State acceptance and QC stations with state-of-the-art instrumentation.

My colleague has only touched upon one aspect of the problem, mechanical measurements. It is much more difficult to solve the other one: equip all machine building plants with automated instrumentation. A lot is being done in this respect now, and certain things have been corrected, first of all at 90 plants in our industry that operate under the State acceptance conditions. Production of a large number of NDT and vibrometry equipment has been organized. This equipment is used for testing virtually all types of machines, because nowadays one is talking about the machine building complex as a whole. With this goal in mind, production of special information-computing complexes (ICC) has begun. Granted, there are not too many of those yet, just several hundred. But these ICCs are rather universal, so various types of testing centers can be equipped with these complexes. One such complex, a specific purpose complex for testing internal combustion engines, has been manufactured for over two years (there are exhibits of this type at the Show).

Naturally, the work has not ended at this point. I can assure you that at the pace we are moving during the current Five-Year Plan the situation will be improving. However, the demand is so high that during the next two to three years we will only solve the most urgent problems.

Reporter. We keep talking machines, computing complexes, instrumentation. But what about man? Has his role in production been identified?

G.I. Kavalerov. Indeed, when preparing for the Show we had been examining this problem again and again. In the end, it had been addressed, and as a result special Show sections are devoted to what we now call the "human factor". This includes creative technical work by the young people, informal professional associations (including quality groups), care for working people under the "Man Gives to the Plant, the Plant Gives to Man" slogan, personnel training and skill improvement, and elections of some managers, i.e. a broad spectrum of social problems.

These sections begin at the booth "Modern Management Science: Contribution to Practice". We, and I am not only speaking for Minpribor but also for other Ministries and agencies, have tried to approach social processes that are taking place in our society from the standpoint of general principles of managing technical and man-machine systems, in order to see which factors can be put to serve the perestroyka.

Reporter. There is a large section at the Show that describes joint achievements of CEMA member countries in the machine building field, but there is not a single booth or exhibit that would show, however briefly, the goals and objectives of product certification. Meanwhile, at the 43th (extraordinary) Meeting of the CEMA session (October, 1987) heads of governments of the socialist communitiy countries signed a Convention on

Creating a System for Assessment of Quality and Certification of Mutually Delivered Products (SEPRO SEV). Its objective is to improve the technical level and quality of products made by the fraternal countries and to make them competitive in the world market. What can you say in this respect?

A.F. Kamenev. Let me make it clear: accreditation of head testing centers for the right to conduct certification tests is performed by Gosstandart SSSR.

A necessary condition for existence of such centers is their full independence of product manufacturers, therefore representatives of Gosstandart territorial agencies are included. As of now, only nine such centers have been created, which is of course not enough at all.

It is anticipated that by the end of the Five-Year Plan around 50 head centers will have been accredited for conducting product testing in order to determine product conformance to world standards.

V.P. Morozov. Within Minavtoprom one of the country's first such organizations, the head testing center based at NAMI [Scientific Research Automotive Institute] automotive proving grounds in the town of Dimitrov was created. UN EEC has awarded it the "E" sign. This proves our preparedness to presales certification of domestic cars, first of all VAZ-2108, and components therefor (including those imported from Yugoslavia). Granted, this center cannot yet conduct certification car testing for conformance to all UN EEC rules (the proving grounds has kind of just opened a door to certification), but we are striving to catch up with Western countries in this respect as soon as possible. Incidentally, the "Lada" car exhibited at the Show was tested in Dimitrov.

L.P. Safronkov. I can tell you that our Ministry participates quite actively in this work. Thus, we have recently completed certification tests of automotive electrical equipment and proved that it fully conforms to the world level.

As to other types of products, we have started certification of explosion-proof motors, durable household electrical appliances and other potentially exportable products. Certification is conducted by head testing centers created at PO [production association] "Elektrobytpribor" (Kiev), NPO "Elektroterm" (Moscow) and VNIIVE [not furhter identified] (Donetsk) and accredited by Gosstandart SSSR.

A.M. Skrebtsov. We have made a decision: certification of agricultural equipment will be mainly conducted by machine-testing stations (MIS) of Gosagroprom SSSR [USSR State Agroindustrial Committee], where the MIS system is well developed. On its part, Minselkhozmash will organize near Odessa a specialized center forcertification of various makes of tractors. The preparatory work is in full swing...

Such was the conversation, and no comments are needed but maybe one: the Deputy Minister of Machine Building for Light and Food Industry and Household has actually evaded the question on the Ministry's role in fine-tuning relations between the State acceptance and management of industry's enterprises, which brings about certain thoughts.

One other thing.

Because the conversation centered mainly around important directions in Gosstandart SSSR activity, such as State acceptance, metrological support of production and product certification, it is a pity that the Committee representatives did not participate. One can assume that reporters would have gotten more comprehensive answers that would have made it possible for them to better understand processes that are taking place. As M.S. Gorbachev stressed during his meeting at the CPSU Central Committee with managers of mass media, ideological organizations and creative unions on January 8, 1988: "It is mandatory that we exchange views and thoughts and have friendly discussions. It is for this reason that we attach a great importance to meetings with you..." (PRAVDA, 13 Jan 88).

Captions

Single-Station Universal Machine Tool for Superprecise Machining of Holes in Base Members of Hydraulic Equipment in Small-Series and Mass Production. It can be built into automated lines. A joint development by USSR and NRB [the People's Republic of Bulgaria] professionals. Annual savings - R30,000.

RB-290-01 Industrial Robot. Designed for automating main and ancillary work. Lifting capacity 6 kg; 5 degrees of freedom; positioning accuracy + or - 0.2 mm.

KI-13805 Stand. Designed for testing transmission drive shafts of K-700 and K-701 tractors and modifications thereof. Hourly output 3 pieces. VEF-287: Portable Stereo Radio and Tape Recorder of the Highest Group ofSophistication. Its quality parameters conform to the best foreign analogs.

Robotic Complex for Plasma Cutting and Welding of Stamped Metal Structures, Cutting Various Shape Windows in Pipes Etc. Positioning accuracy + or - 0.1 mm. Developed by the USSR and CSSR [the Czechoslovak Socialist Republic] scientists.

LA-45 Line for Automated Assembly of Cylinder Heads of Internal Combustion Engines. Hourly output 86 pieces, cycle time 42 s. 16 automated stations. Can conditionally free up 40 workers.

MGP-2107-04 Pull-Type Nutdriving Module. Designed for unscrewing, greasing and screwing on nuts of clam-

pand insert rail anchor bolts. Can be operated at temperatures from 0 to +40 °C. Productivity 1,000 m/h.

12770

Ninth Congress of Technical Society of Machine-building Industry

18610152a Moscow LITEYNOYE PROIZVODSTVO in Russian No 2, Feb 88, pp 2-3

[Material compiled by engineer I.A. Yaskevich]

[Text] The congress of Mashprom's NTO [Scientific and Technical Society] held during a critical transition period of our society, reflected in its work and decisions the all the complexity that has accumulated in machine-building problems. The results of the new elections preceding the congress showed that the scientific and technical community supports the party's firm policy on restructuring and renewal, on resolutely overcoming stagnation and conservatism in all its manifestations.

Many initiatives have sprung up in the NTO during this period. This includes the creation of temporary creative collectives, the conduct of public appraisals in projects for the technical reequipping of enterprises, and the engineering assist of many factory starts, and much else. New forms of working with the public also appeared in the NTO, such as the "idea fair", auctions of finished studies, the creation of consultation offices, public membership on the boards of the NTO, and so forth.

The struggle to accelerate scientific and technical progress and to put the economy on the intensive path of development is one of the basic tasks of the NTO, and many primary organizations take a creative approach to its realization. At the same time the work of the NTOs organizations has begun to take the form of statements on existing achievements and deficiencies and general appeals to improve work, but some have chosen to take the credit for what was done by labor collectives without the NTOs participation, hiding their inactivity by such accounts. During the period of scientific and technical acceleration, many forms of the NTOs work were shown to be hopelessly outdated. Thus the practice of organizing all-union public exhibits of new technology, the tradition of conducting scientific and technical conferences, and many other things demand reexamination.

The NTO must direct its activity to solving those problems on which the fate of perestroika in the machine-building sector depends. These are primarily challenges of creating technology equalling or surpassing world standards, mechanizing or automating heavy and dangerous labor, technological reequipping of production facilities, reducing metal and energy consumption of new machinery, and making optimal use of scientific and technical potential. *The task of paramount importance to the State is to radically increase the quality of output.* According to the estimate of the USSR State Committee for Standards (Gosstandart) the yearly economic loss just from defects in production is about one billion rubles. A third of all productive capacity is being used for maintenance and spare parts, which costs the state 55 billion rubles a year.

The acceleration of scientific and technical development requires the efficient use of material resources. Right now the losses of metal in the form of industrial waste and shavings amounts to 20 percent, which in machine-building alone comes to 8 million tons of metal. Each year 15 million tons of equipment and metal structures rust and are scrapped.

All these challenges require the creativity of scientists, designers, engineers, inventors - all members of NTO. Plants and institutes should be aware of NTO help, especially now when they have to solve many technical and economic tasks simulatneously.

The situation which has arisen in machine building is aggravated by the fact that the period of stagnation and bureaucratic management methods in our industry coincided with a period of active assimilation of computer technology and radical renovation in production, transformed by newer technologies and highly productive equipment from abroad. Massive purchasing of imported equipment has played a negative role in the development of domestic machine-building. In those industries where purchased equipment was not counted on, the creative work of designers continued and it produced its own results.

The scientific and technical community must be actively included in the solution of a task of extreme complexity - to renew the machinery pool completely within eight years. We must go from a deep-seated process of retarding creative initiative to an active process of creation (from a conference paper by I. S. Silaev). *Currently the quality of production is regarded as of paramount importance, but quality begins with research, investigation, design, and technology development.* A number of measures have been taken to simplify the procedure for coordinating technical documents, and abolishing all restrictions on the developer's selection of components, materials, and types of processing.

The whole world has come around to the fact that equipment should be delivered to the consumer with its features already tested and that this guarantees that the consumer will learn to handle it more quickly. The most important condition in the making of new equipment is its thorough testing, but until now we have been handicapped from the lack not only of test facilities, but even the simplest measuring instrument.

Modern enterprises abroad are managed by the slogan *"zero defects, zero breakdowns, zero reserves"*. Our labor productivity is several times less that of leading capitalist countries, and if one-third of the blame for this shortfall

lies with our level of equipment and technology, then two-thirds is the fault of our labor management and production standards (from paper by P. N. Belyanin).

Gospriyemka [State Acceptance Commission] has revealed major shortcomings in the operation of enterprises: there is an extremely low rate of renewal of basic funds (0.5-5 percent per year); an unsatisfactory production rhythm (if in the first twenty days of the month only 10-12 percent of output is presented for inspection, then in the last 10 days up to 80 percent is presented); gross violations of operating discipline excluding in a number of instances the very possibility of producing high quality products. From January 1, 1988, formal state acceptance has been introduced at plants delivering materials and components which causes additional difficulties in supplying enterprises.

More active participation of the NTO is essential in the preparation and examination of standards. As a result of work carried out in 1986-87 by Gosstandart more than 50 percent of the State All-union Standards for machines, equipment, and materials contain values corresponding to the world standard (from paper by V. N. Sokolov). The transition of enterprises to self-financing requires a more flexible approach to the normative and technical documents. So, is it necessary to stop producing a product which does not measure up to world standards but nevertheless finds a demand in the domestic market? We ought to pay more attention to the remark of one of the conference delegates about the fact that in the USA a scientific and technical society issues the standards while an organization similar to our Gosstandard in general does not exist.

We must more widely use special interdepartmental competitions for better construction, design, and technology. The results of such competitions are very effective. Scientific and technical collectives are already now being created in order to solve the most difficult technical problems, for example for the solution of casting production problems at the GAZ Production Association, VAZ imeni 50th Anniversary of the USSR, and KamAZ (from paper by A. V. Butuzov). There are examples of computer time-sharing. We ought to extend this practice to machine time of unique equipment which is often idle. In the automotive industry there have already been created six scientific and technical centers which have been called upon to solve, among others, problems of reducing time spent on training and mastering new equipment; problems of creating computer-assisted design at plants and of organizing software exchange; problems of creating and mastering progressive technological processes.

Much was said at the conference about the role of science and design developments in the evolution of machine-building. In the 12th Five-Year Plan 5 times as much resources as in the 11th Five-Year Plan will be spent on the development of a base of research institutes and design bureaus (from paper by I. S. Silayev). But in order to catch up to the world level of machine-building production from our present position, the time for creating technical documentation must be shortened by 4-5 times. If the designer does not know the world standard for the design he has done, he is not fit for his job. Even if we do not know exactly what they are working on abroad, we are obliged to predict the course of world technical thought and, based only on that, create new domestic technology.

The essential technical equipping of designers' and engineers' work places can be added to self-financing as a powerful lever of engineering initiative. While in 1986 there were 500 engineers for each computerized work station, in the future there will be 25 specialists for each work station. Much is being done right now towards solving this problem.

All these very complex problems cannot be solved without the active involvement of the engineering community. In the opinion of the leaders of the BCNTO [All-Union Soviet of Scientific and Technical Societies] the NTO organizations must become a system of public management of scientific and technical progress (from paper by A. P. Vladislavlev). *we are talking about the creation of a public system which could become a partner, and when necessary, even an opponent, of economic organizations, a system which could support the accelerated implementation of advanced concepts and proposals in the national economy.* Especially as correctly attributing the deficiencies of the past to the voluntarism of economic managers is insufficiently established, we have not had a reliable defense from it up till now. Only creative organizations, combining the cream of the scientific and technical intelligentsia, can become a barrier to the monopoly of higher organizations in the disputed questions of science and technology, which has formed over the decades of the command economy.

First of all it is necessary to raise the prestige of the NTOs work and to plan and coordinate the efforts of all supporters of scientific and technical progress. It would be correct (and the BCNTO supports this idea) to establish a new creative union in this country - the Union of Scientific and Engineering Societies (with the status of creative association). It is important that NTOs take the form of professional clubs where everyone may receive the most recent scientific and technical information, and to rely on informal contacts in relaxed, unofficial situations. The other side of the question is the involvement of NTO in cost-accounting activities, and the establishment of creative collectives, working on the solution of concrete scientific and technical tasks. The matter is quite delicate because it is a question of, on the one hand, the qualitative effective solution of important problems, but on the other hand, of the possibility of large earnings. Therefore, it is necessary to protect this process from unscrupulous people by creating a mechanism for reasonable mutual relations between the NTO and its client. A mechanism for planning the NTOs activity should also be thought out. The basis of this

mechanism would be the concrete needs of the enterprises, and all scientific, technical, industrial, and educational sides of the primary organizations' activity would be considered.

The acceleration of scientific and technical progress makes increased demands on the level of knowledge and on industrial qualifications. The necessity of universal participation in the work of improving production quality requires training absolutely everyone in these problems. Here it wouldn't be a bad idea to borrow from foreign experience. In Bulgaria, "Universal Education in Quality" has been organized within the framework of the NTO; in the USA a special society has been created whose main task is training in subjects which assure production quality.

The primary organizations of NTO could combine their activities with the functions of the industrial and technical, technical and economic, and scientific and technical councils in plants and scientific organizations. For example the organizations of KamAz, MAZ, and ChTZ imeni V. I. Lenin, where they fulfill the role of social developers and experts in enterprise development trends. An experiment is being conducted in a number of fields on combining the efforts of NTO and All-Union Society of Inventors and Effieiency Experts organizations.

A matter of particular concern to the NTO must be working with youth. We can take as an example the experience of Bulgarian founders who have created a subsection of junior founders and have already twice conducted international schools of young founders. Their creation was supported by the Union of Communist Youth of the People's Republic of Bulgaria and by the Council for the Coordination of the Efforts of Member Countries of the Council for Mutual Economic Aid. Our Bulgarian colleges have proposed to offer a free trip to participate in the next young founders' school as a prize for the best work of a young specialist, considering beforehand the materials sent in at the session of the founding section or at the editorial board of the journal "Founding Industry". In the Soviet Union a unified public-state system of scientific and technical creativity of youth is being created, and within the framework of this system young specialists ought to become more active; in particular they ought to be drawn to the work in the founding section and to participation in conferences, Founders' Days, and competitions.

The activities of scientific and technical journals at the conference were given, in our view, insufficient attention. After all it is well known that today's engineer does not derive his principal information from books, which take too long to read for the current pace of scientific and technical development, but from journals. Therefore, we should pay more attention to the problems of journals, especially with their transition to self-financing and paying their own way. So the size of the journal "Founding Industry" is clearly insufficient if we are to consider the range of interests of the founders and the responsibility of the founding industry for the quality of all machine-building output, but there are not enough returns from the circulation sales and the publication of advertising to expand the editorial staff or the size. The journal which provides the most important group of machine-builders, the founders, with operational information, must be aided by its publishers - USSR Minstankoprom [Ministry of the Machine Tool and Tool Building Industry] and the NTO of Mashprom. We need to explore the relationship of journals with scientific and technical books. It is also necessary to search for continuity of journal and book publication and creation of a common author and editor organization.At the conference it was proposed to more precisely define the title of the NTO of the machine-building industry. From now on it will be called the All-union Scientific and Technical Society of Machine-builders (VNTOM). A number of changes and clarifications were introduced into the regulations of the Society. The new wording stipulates a reduction in the number of meetings, sessions, and other measures which before were obligatory and simplifies the voting procedure. It also stipulates the additional right of Society members to participate in creative collectives working on a contractual basis, and a preferential right to conclude agreements with higher organizations for conducting research and development and training of specialists.

12805

Improving Efficiency of Cooling Blade System of High-Temperature Gas Turbines

18610178a Moscow ENERGOMASHINOSTROYENIYE in Russian No 2, Mar-Apr 87 pp 8-11

[Article by Doctors of Technical Sciences I.I. Kirillov and L.V. Arsenyev]

[Abstract] One way of increasing the efficiency of gas turbines is to increase the initial gas temperature. This has led to increased demands on blade cooling systems as well. One way of meeting these demands is by developing stages with flow speeds approaching 400-450 m/s, which is attainable using current materials and high-heat-capacity coolants. The Ministry of Power Machine Building has organized a special branch laboratory at the Leningrad Polytechnic Institute which has, in cooperation with the Turbomotornyy Zavod PO and the Nevskiy Zavod PO, done some experimental work on prototype stages with internal efficiency up to 90%. Another way is by intensifying the heat transfer through blowing of coolant in streams into the passages, or by putting cylindrical inserts or rods in the passages as turbulizers. Improvements of 40-50% in the heat transfer coefficient have been thus acheived. Yet another way is by using steam instead of air as the cooling agent. LPI modified a GTE-150 turbine for this and achieved 36% efficiency at 200 MW output power. Figures 5, references: 13 Russian.

12733

Technical Tribology Problems in Far North Regions

18610104 Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR: SERIYA TEKHNICHESKIYE NAUKI in Russian Vol 18, No 5, 1987 (manuscript received 1 Jul 86), pp 106-112

[Article by I.N. Cherskiy, Physical Technical Problems of the North Institute, YaF SO AN SSSR [Yakutsk Affiliate, Siberian Department, USSR Academy of Sciences], Yakutsk]

[Text] Ensuring high serviceability and longevity of machines and mechanisms is one of the most important aspects of the activity of technical profile Institutes of the Siberian Department of the USSR Academy of Sciences.

It is well known that under winter conditions in the northern and northeastern part of the USSR equipment productivity in the open air decreases by approximately 50 percent, MTBF decreases by a factor of 2 to 3 and the actual service life decreases by a factor of 2.5 to 3.5, which causes annual losses in the billion R [1]. Main reasons for this are insufficient frost resistance of materials used, unfitness of certain components, units and equipment as a whole to long-term effects of cold climate and design and organizational deficiencies.

A significant share of equipment defects and failures is caused by low reliability and durability of friction joints (FJ), such as bearings, gear trains, clutches, pistons, sleeves and cylinders, seals and packings, parts that interact with frozen rock, etc. This is the application field for tribology, a science of friction, wear, and lubrication of solids.

The objective of the article is, without touching upon theoretical aspects of tribology, to analyze causes of decreased FJ serviceability and durability in machines and mechanisms and formulate general requirements to developing FJ capable of ensuring reliable long-term equipment operation in Far North regions.

In our analysis, we shall examine three groups of main factors that affect FJ operation: physical, organizational and design and planning.

Objective physical factors are caused by changes in physical nd mechanical properties or specific features in the behavior of materials and structures under the influence of cold climate factors, such as low temperatures (-35 to -30°C), sharp temperature drops going through 0°C, high solar radiation, etc. Effects that occur in these cases can be either reversible, manifested, for instance, in changes in tribological and other characteristics of materials as temperature decreases, or irreversible, manifested in degradation of material properties during climatic aging.

Figure 1 shows the effect of subjective physical factors on operating characteristics of friction joints in cold climates.

Figure 1 schematically presents the effect of physical and mechanical properties of materials on their serviceability under cold climate conditions. One can see from the scheme that the above factors can be classified in accordance with the degree to which they affect FJ operation and with effects they cause.

The first group that directly affects FJ serviceability includes reversible changes in physical and mechanical properties of materials at low temperatures. These are, first of all, increased friction coefficients of virtually all materials as temperature for polytetrafluorethylene, a polymer material that is one of the most widely used for plain bearings and seals [2].

It is well known that under negative temperatures viscosities of oils, lubricants and hydraulic fluids increase sharply. Thus, viscosity of hydraulic oil AMG-10, which is widely used in various machines and mechanisms, increases from 2 to 125 x 10^{-5} m^2/cm as temperature decreases from 20 to -50°C. These factors are direct

causes of disturbances of normal FJ operation at low temperatures, increased power consumption, increased break-away forces and friction moments, and excessive loads on structural elements.

Reduction in elastic properties of rubber and polymer materials used for seals in hydraulic, pneumatic, fuel, and other systems is a direct cause of deterioration of FJ serviceability at low operating temperatures. The reduction in or loss of elasticity of seals, rings, and other sealing parts when temperature decreases results in system unsealing, leaks of working fluid and gas, reduced nominal capacity of equipment and environmental pollution.

Figure 2 shows the temperature dependence of the polytetrafluorethylene friction coefficient.

One can see from the scheme in Figure 1 that not only direct factors adversely affect normal FJ operation, but they also reduce the service life and in some cases cause fracture of equipment components and parts.

The second group of factors includes changes in material characteristics that do not directly affect FJ operating indices at low temperatures, but significantly reduce FJ service life. Thus, for instance, the tenency of increased wear at negative temperatures which is typical of the majority of materials used for friction pairs clearly reduces FJ operating service life.

Changes in material properties because of aging are another factor that reduces FJ service life. Rubbers, polymers and composite materials are most [sentence incomplete]. For a large number of them, the coefficient of friction increases, wear resistance decreases and deformation and strength characteristics deteriorate in the process of aging. Besides, for rubber materials used in seals the glass transition temperature shifts toward higher values, which also reduces the service life and adversely affects normal operation of seals. Not only these factors reduce the service life, but they also can cause premature breakdowns and failures of FJ parts.

We shall call indirect physical factors the changes of those physical and mechanical properties of materials or environment that are not frictional but cause reduction of the service life or fracture of FJ parts.

One of the most important indirect factors is the tendency of most structural materials (metals and alloys) to brittle failure and reduced fatigue strength at temperatures below -40°C. As a result, when other physical factors (increased coefficients of friction and viscosities of oils and lubricants etc.) are added, the number of breakdowns and failures of FJ parts (bearings, gears, couplings, etc.) and other structural parts that carry loads determined by FJ operation increases sharply. Problem of brittle failure of metals and metal structures under low temperatures are the subject of special research [3, 4].

Increased strength of frozen soil is another cause of significantly lower service life and a sharp increase in the number of breakdowns and failures of tooling in road construction and mining equipment during the winter operation period. In this case, fractures are caused by higher design forces acting on members that interact with soil, such as bulldozer blades, excavator buckets, drilling tools, etc., whereas service life reduction is due to increased abrasiveness of frozen soil. For instance, it was determined that the rate of wear of undercarriage parts of D-572 bulldozers operating in mining of placers in the Magadan oblast is 2.7-8.5 micrometers/hour, that of middle axle parts is 115 micrometers/hour and that of the ripper tip is over 15 mm/hour [5].

Finally, the third indirect factor that causes failure of FJ parts, especially seals, is moisture crystallization (freezing). Moisture can get into the system either from the environment or it can freeze out from hydraulic liquids, fuel, and oils and condense and freeze to metal and polymer parts. In this case, instantaneous failure of seals and other FJ parts during a system start can occur, or sharply increased wear will take place, when ice particles act as an abrasive. It should be noted that the lower the ambient temperature, the more pronounced are mechanical, adhesion and abrasive properties of ice. Therefore, serviceability and durability of plain and rolling bearings in transportation equipment components, such as aircraft landing skis, snowplanes, vehicle tires, etc., also become considerably lower at low temperatures.

Physical objective factors that cause lower serviceability and durability of FJ operating at low temperatures explain and cause failures, breakdowns and fractures and a sharp decrease of the service life of machines and mechanisms. However, the economic side of the problem also depends to a large extent on subjective-organizational and design and planning factors.

Subjective-organizational factors are those that depend on organization of operation, repairs and maintenance of machine and mechanisms and elimination of which, regardless of objective causes, can considerably reduce equipment downtime and economic losses. Thus, for instance, when an FJ part fails (breaks or wears out), economic losses will depend on equipment downtime, which in turn depends on the availability of spare parts. Existing standards for supply and consumption of spare parts do not take into account specific conditions of operation in the Far North regions, so shortages of such mostly inexpensive parts as seals, rings, plain and rolling bearings, hoses, etc. are created artificially. This problem has not been solved on the country scale, so enterprises-users are forced to organize in-house manufacturing of some FJ parts. Thus, in the Yakut ASSR enterprises at production associations "Yakutzoloto," "Yakutugol" and others have their own production departments that make rubber parts. Among other subjective factors are ensuring that specifications on mandatory preheating of

FJ before starting a machine during cold periods are obeyed, preventive maintenance of FJ is performed, oils and lubricants are change din the winter and other measures are taken.

A number of factors that adversely affect FJ operation and to a large extent determine the effect of both objective physical and subjective-organizational factors are designed into machines and mechanisms during their development and testing. In this group of factors that were given a common name "design and planning factors," three main ones should be singled out: material, design, and experimental.

The material factor, determined by the selection of materials for an FJ, adversely affects the FJ operation, insofar as service properties of the material deteriorate due to the effect of low temperatures and other features of cold climate. At the same time, available laboratory studies of material properties are not always sufficient for making an optimum selection of FJ material. It has been noted earlier that the use of rubber materials for seals of machines operating in the Far North regions, even if rated frost resistance of these materials is -40 to -60°C, results in numerous failures and force equipment downtime, because at these temperatures rubber elasticity is 5 to 20 times lower and it looses its sealing feature. Analysis of winter operation of dynamic seals in domestic and imported machines in the Far North regions demonstrates that they cause 20 to 80 percent of forced downtime and failures [6, 7]. Polymer materials used in FJ in many cases do not have the necessary frost resistance either, and then fail under winter conditions. This is first of all true for plain bearings, seals and rings, brake-clutches, pump impellers, gear trains, and other parts made of polyethylene, polyamide, polyvinylchloride and polyurethane.

The design factor is due to the fact that during machine development design serviceability and durability indices are not always determined with consideration to extreme operating conditions, particularly low temperatures. This is true for the most simple engineering calculations, as well as for more complicated service life forecasting methods that involve complex computerized calculations. Thus, for instance, design calculation of assembly clearances between parts made of materials with different coefficients of thermal expansion (metal - polymer) is usually conducted without taking into account temperature fluctuations. As a result, when these FJ operate at -40°C and below, clearance between rubbing parts can disappear completely, and when a machine is started then either the engine does not have enough power to break off or a weaker part breaks. Obviously, a slightly bigger clearance that should have been provided during FJ design would have completely eliminated such phenomena during operation.

It has been noted earlier that friction torques and wear of FJ parts during machine starts at low temperatures are much higher, which reduces the overall FJ service life. Generally speaking, transient friction modes have a considerable and sometimes determining effect on the overall FJ service life under cold climate conditions. Although a precise forecast of such phenomena is a very complicated problem, completely ignoring nonstationary tribologic processes at low temperatures results in tremendous overestimates of design FJ service life with all attending consequences.

The effect of the experimental factor is determined by a complete absence or an insufficient scope of laboratory, stand and other types of tests scheduled at the FJ design stage in order to identify possible defects and failures at the Far North regions. This is first of all determined by economic considerations, because such tests are conducted in rather expensive cold chambers, where the experiment time is limited. Even when an FJ is tested in a cold chamber separately, experimental results only make it possible to make a judgment regarding FJ serviceability, but not its service life, whereas complex equipment testing under real Far North conditions are conducted very seldom, because it is hard to organize them.

Figure 3 shows the integrated stage-by-stage scheme of developing frost resistant friction joints.

We shall now examine the problem of development of frost resistant and durable FJ for equipment operating in the Far North regions. Figure 3 presents a scheme of integrated stage-by-stage development of frost resistant FJ that covers the most important aspects. According to the scheme, the first stage of FJ development is a comprehensive and thorough analysis of operating conditions, which results in making a decision on the need in principle to develop a special FJ and developing a request for proposal (RFP). In turn, the RFP makes it possible to make a decision on selection of main materials and on the need to develop new materials if existing ones do not meet RFP requirements. Next, experimental studies in order to determine properties of the selected material over the required range of operating conditions are conducted. Of course, if it is a traditional material and its properties have been studied sufficiently, an accumulated data bank or reference literature is used.

According to RFP requirements and taking into account the selected material, the FJ design stage begins. It is important to decide at the very start of the design stage whether the FJ will operate under natural conditions or special design solutions are necessary for its functioning, such as, for instance, additional heaters. Selection of FJ material and design configuration makes it possible to make a decision on the technology for manufacturing of rubber parts (seals, bushings, bearings, etc.), which can be either traditional or specially designed for specific parts and assemblies. In turn, technology selection makes it possible to make experimental prototypes of FJ parts that fit the adopted design.

Actual values of service properties of selected materials over the required range of operating conditions and FJ design configuration, derived as a result of experimental studies, form a basis of design forecasting of serviceability indices. Concurrently, experimental prototypes undergo laboratory tests under simulated operating conditions. According to the test results, design serviceability characteristics are concerned; based on these characteristics and using properties of materials, forecast of FJ reliability and durability under operating conditions is calculated. We examined problems of design and development of frost resistant FJ in [8-11].

The final stage consists of full-scale tests of a unit (engine, system) or an entire machine. In accordance with test results, reliability indices are corrected, and a decision on production implementation of FJ is made.

Experience of the Physical Technical Problems of the North Institute in developing frost resistant seals and snow and ice sliding supports has demonstrated that it is as a result of studying all aspects of the problem (material, structural, technological, design and testing) included in the experimental scheme that one can develop reliable and durable FJ for operation in the Far North.

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12770/06662

Automotive Institute Develops Gas Diesel Engine for Truck Tractors

18610163a Moscow MOSKOVSKAYA PRAVDA in Russian 20 Mar 88 p 1

[Excerpt] In collaboration with the Kama Automotive Plant (KamAZ), scientists of the Central Scientific Research Institute of Automobiles and Automotive Engines (NAMI) have developed an engine whose design is new in principle. Tests of a diesel engine for trucks which is designed to run on gas fuel have now been successfully completed at NAMI. This is the first industrial development of such an engine in world practice.

Up to now, diesels operating on gas have been employed solely in stationary and ship engines with fixed loads. NAMI's development ensures a fuel-air mixture whose composition is optimal in rapidly changing speed and load conditions. Up to 80 percent of the fuel can be replaced by gas fuel in the new engine.

Operational trials of an experimental-industrial lot of "KamAZ-53218" gas-diesel truck tractors proceeded simultaneously with the perfecting of the new engine. The results were positive, and industrial production of gas-diesel trucks has begun for the first time at the automotive plant on the Kama.

/9604

New Equipment in Technical Retooling of Enterprises

18610282 Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 2, Feb 87 pp 2-3

[Article by V.S. Kulshan, engineer, and V.I. Mezherits-kiy, engineer]

[Text] Introduction of new equipment plays an important role in intensification of production. There are different, frequently contradictory definitions of this concept in the economic literature. One is guided by the requirements of official methods in practical activity during selection and economic evaluation of machines and equipment. This was the reason for inclusion of a list of measures in plans for new equipment on introduction of hardware that does not correspond to the modern level.

Thus, along with essentially new, progressive machines and equipment such as automatic lines, automatic manipulators with program control, metal-cutting tools with numerical program control and equipment for plasma machining, hardware unrelated to a number of progressive machines—tilting welding jigs, finish machining tools, eletroerosion machine tools for removal of the remains of a broken tool, mechanized one-spindle thread-cutting tools and so on are indicated in the integrated plans for the economic and social development of enterprises in the section "New equipment." Introduction of them is directed toward improvement of technology and may be effective at a specific enterprise, but it is impossible to include the given equipment among new equipment.

Inclusion of these measures in plans for new equipment permits an increase of the qualitative indicators through the use of easily realizable, but rapidly aging or obsolete engineering solutions.

This approach does not correspond to the postulated tasks to renovate a plant on the basis of its technical retooling and redesign and of increasing the level of automation and mechanization. The concept "new equipment" should be limited only to scientific and technical advances, corresponding to the worldwide level or exceeding this level, realization of which makes it possible to increase considerably, within compressed deadlines, labor productivity and contributes over a long period of time to improvement of the technical and economic indicators of industry.

The maximum saving due to introduction of measures on new equipment is usually achieved with integrated solution of the problem of increasing the technical level of production, i.e., during technical retooling, which contributes to reaching the required technical level of production by introduction of low-waste and resource-conserving technology, progressive methods of machining and new equipment, accessories and tools, by integrated automation of manufacturing processes using computer technology through development and introduction of flexible manufacturing systems, automated manufacturing systems, robots and robotized manufacturing systems that provide a sharp increase of labor productivity and achievement of high quality of manufactured products.

The use of this new equipment, which fully corresponds to modern requirements, is envisioned in the plans for technical retooling at leading machine-building enterprises of the republic. Thus, a draft of technical retooling of the Kotelnyy Agricultural Machinery Plant (Volgograd Oblast), in which the use of robotized manufacturing systems, automations and semiautomatic machines and machine tools with numerical program control is envisioned, was worked out at PKTIselkhozmash [possibly Planning Design and Production Institute for Agricultural Machine Building].

Progressive solutions on development of mechanized variable production flow lines for machining, closed product assembly plant, the principle of group machining of technologically and structurally similar products in the painting plant, the use of mechanized warehouses and conveyors for moving parts and assemblies and for removing chips permit one to achieve the following indicators: 82 percent of the specific proportion of progressive metal-cutting equipment, 97.4 percent of the scope of production operating mechanized and automated labor, 0.8 percent of the equipment load factor, 1.8 percent of the equipment operation interchangeability factor, 20 percent of the level of use of automation and mechanization devices for assembly operations and 98 percent of the specific proportion of progressive methods of painting. The annual output of products increased 2.5-fold in wholesale prices with a 1.3-fold increase of the numbers of workers.

06521/09599

Improved Quality, Wise Choices in FMM Systems Urged

18610172a Moscow NTR in Russian No 4, 16 Feb-7 Mar 88 p 5

[Article by V. Push, Doctor of Technical Sciences, Professor, head of Department of Design of Flexible Manufacturing Systems with Microprocessor Control at Stankino, Meritorious Figure of Science and Technology of the RSFSR, and B. Bushuyev, Doctor of Technical Sciences, Professor of the Department of Design of Flexible Manufacturing Systems With Microprocessor Control, Stankino: "Why Is the Flexible Module Not Flexible;" first paragraph is introduction]

[Text] We began the series of publications, devoted to development of Soviet machine tool building, with the article "The Machine Tool Is Requesting Work" (NTR,

No 2, 1988). Everyone understood the main task—to bring the quality of manufactured machine tools closer to the worldwide level and to manufacture them in the necessary quantity to meet the needs of the national economy and the demands of the foreign market. But what are its achievements? How many and which machine tools do we need within a year, within 5 years and within 10 years? Will these be flexible automated systems or rotary lines and perhaps automated plants? And what is delaying the accelerated development of the machine tool building sector? There are different viewpoints on this question. In today's article, the stage is given to representatives of the Moscow Machine Tool and Tool-Building Institute.

There have long been arguments in machine building as to which method of machine materials is more progressive and perhaps more optimal. However, we feel that they are unfounded and even harmful. One can not say that the stamping method is more efficient than machining or casting and vice versa. Each of them is good for their area of application and each has its own advantages and disadvantages. And attempts to replace the entire range of techniques of machining materials by any one universal method are simply hopeless.

For example, stamping is a highly productive process, very effective in mass or large-series production, when parts of the same shape must be copied. Casting is more suitable for the phase of prefinish machining of a blank. But machine tools as yet have no equal in the final stage of producing a part.

Approximately 70 percent of all operations in machine building are executed by machining. This indicator reflects the universality of the method. No other of the methods of machining now known permits simple combination of rotational and forward motions and as a result, a product of as complicated a shape as desired can be produced. Add to this the highest precision of machining (up to hundredths of a fraction of a micron!)—again incompatible with any other method—and great flexibility in readjustment of production, for which hours are required.

There is yet another principal difference. Only the surface layer of material is mechanically affected during machining. Whereas any other method assumes more serious physical intervention in the structure of the material: heating, deformation and so on. The power expenditures are also incomparable. One can machine practically any material—even a superhard material—on a machine tool. The cutting tool in this case can be replaced with a laser beam, but the principle of machining remains the same.

Work at superspeeds has recently been attracting ever greater interest of machine tool operators. Whereas machining is now performed at a speed of 200-300 m/min, one can achieve quite amazing results of machining the most diverse materials by increasing the speed to 1,000-2,000 m/min. This effect is explained by the physics of the cutting process: heat is dissipated together with the chips at super-high speeds and the blank simply does not manage to heat up. Experiments to study this characteristic of machining and how to apply it in practice are now being actively conducted. And this only one of the ways of improving machine tools.

We are convinced that the future of machine tool building is development of flexible machine tool module systems. The module is a completely automated machine tool with its own control system and with the necessary peripherals, which is capable of operating according to a given program for an entire shift without intervention of the operator. The basis of the machine building industry is now dispersion of various types of essentially unrelated machine tools. But if they are replaced by a system of modules, built into a single production chain, labor productivity may increase by an order of magnitude. Having created an automated plant from these systems, we will be able to increase labor productivity by another order of magnitude. In other words, only 10 persons will be required at this plant instead of 1,000. But the automated plant is still not the limit. Following it, there is the temptation to organize an entire sector of the machine-building industry from automated plants that is encompassed by a single control system. This will permit an increase of labor productivity by at least another order of magnitude—due to better production contacts and organization of labor.

These prospects can be fully achieved in the future. However, let us return to today's reality. How is machine tool building now developing? Regardless of how painful it is to say this, it is frequently developing at "breakneck speed." For example, a command comes from above: "Introduce 50 robots at the plant!" This directive is usually not supported by any computations or analysis: is the innovation feasible at this specific plant, will the expenditures be recovered, will there not be a loss to existing technology? The main thing is to fulfill the directive and report it. Uncoordinated equipment, which,as a result, lies in a dead heap of unnecessary metal, is frequently acquired. Or there is the other extreme—introduction of new technology on the principle "an earring each to each sister:" one NP machine tool is delivered to each shop—the plant has hardly been renovated by this.

All these are external features of technical progress. Instead of the expected acceleration, these actions only inhibit progress in the sector. Without having reorganized machine tool building and without having fundamentally renovated the country's machine tool stock, it is difficult to count on success in restructuring [perestroyka] of machine building.

What then must be do first? We must first create conditions to convert machine tool building plants from output of scattered types of machine tools to flexible

manufacturing modules. This technology is still perceived by manufacturers as something exotic. Modular systems have still not yet become the main concern of the plants. Their bread and butter today is largely obsolete models of equipment. Under the conditions of the shortage and absence of a free market and competition, the customer is happy to receive even those models. We must manufacture products!

Further. Conversion to new generation machine tools—modular system—very acutely poses the problem of the reliability of complete sets of products and of the machine tool module as a whole. Moreover, we have not yet had specialized production of many assemblies and parts that are vitally important to machine tool building. For example, electric motors are assembled under the same conditions and with the same specifications as the motors of automotive fans. After all, this is the heart of the machine tool. The slightest unbalance results in the cutter being unable to machine, but of literally "plowing" the part, leaving something like a "10th wave" on its surface. The machine tool operators must independently, by the handcraft method, modify the electric motors: rewind the electric coils and balance and modify the control system. And all this because it is more advantageous to the supplier plants to make 10 electric motors for consumer goods than one motor, modified to the proper condition, for machine tool builders.

The reliability of control computers is a very serious problem. Here we seriously lag behind Western countries. It is not enough that the machine tool modules must be fitted with obsolete electronics, but it is even of extremely low quality. The lion's share of failures is due to just this electronic control equipment. Industrial rubber products are also contributing their "bit" to the reliability of the machine tool. The manufactured equipment is now supplied with a set of two or three drive belts. All this because they frequently break, causing the machine tool to fail. They are thus trying to convert quantity to quality. Should one be surprised then that the mean time between failures for the best Soviet machine tools now comprises 200-250 hours, whereas this indicator in Japan, for example, is measured in months and even years!

And finally, there is yet another paradox in development of machine tool building. Despite any logic, the machine tool building plants are unable to leave their own products for themselves—machine tools. (Truly, the "shoemaker's wife is the worst shod"!) A paradoxical situation thus arises: tomorrow's equipment must literally be manufactured on equipment that is 20-30 and sometimes 50 years old! (Even more ancient specimens are encountered in the machine tool stock, which were manufactured even during the last century...)

Speaking of the problems of machine tool building, one can not let go by the fact of the decreasing prestige of the designer's labor. It has been transformed from a creative person at the plant to that of a clerk, buried in various types of papers and tormented by numerous coordinations and reports. Almost any attempt to introduce a fresh idea into production is seen as an attempt to undermine the normal operation of the enterprise. And at one time the designer was the number one person at the plant.

The machine tool building sector is thus operating under these conditions today. As one can see, there is much to do for restructuring [perestroyka] it. And it is necessary to begin now!

6521

USSR's Metal-Cutting, Forging Machine Tools: Facts, Figures

18610164 Moscow NTR in Russian No 2, 19 Jan-1 Feb 88 p 6

[Article by S. Kheynman, Doctor of Economic Sciences: "The Machine Tool Is Requesting Work;" first paragraph is introduction]

[Text] The production apparatus of Soviet machine building has reached gigantic dimensions. According to data of the latest inventory of equipment for 1983, the stock of metal-cutting machine tools and forging-press machines in the USSR is greater than the total stock of machine-building metalworking equipment of the United States, Japan, Great Britain and the Federal Republic of Germany combined. This is a truly enormous volume! What is the status, structure, disposition and use of this enormous potential?

Let us first turn to the disposition of this stock and let us consider what part is used in machine building itself for manufacture of new equipment and what part is operated beyond machine building, in auxiliary shops and services of the enterprises of nonmachine-building sectors of the economy. It is no less important how this equipment is disposed in machine building itself—how many machine tools are in the main shops that develop [sozdayushchiye] new equipment and how many are used in repair and tool shops of machine-building plants, i.e., how many are diverted from manufacture of new equipment.

Figures show that the situation is not favorable. Of every 100 units of metalworking equipment in 1983, 42 were used outside machine building. Moreover, 29 percent of the equipment of machine building plants (17 percent of the country's entire stock!) is operated in auxiliary shops of machine building itself. In short, less than half (41 percent) of the entire stock of the country's metalworking equipment is engaged in manufacture of new equipment. Is this a lot or a little? To evaluate this, it is worth mentioning that only 17 percent of machine tools was used in the United States in the same year outside machine building.

As a result, only the stock of metalworking equipment, which we have within machine building, is almost one-third greater than the number of all machine tools in American machine building according to the number of units. However, it is utilized an average of only 0.3-0.5 of the shift (2.4-4.0 hours per day), i.e., the machine tools are not operating for the greater part of the time (data of the Economic Institute of RSFSR Gosplan). Moreover, this stock is younger in age and this means that it is more modern than even the equipment of machine building itself. The absolute intolerance of this situation is obvious, which of course has nothing in common with the course toward intensification of production.

What is the reason for this inefficient disposition of the country's stock of metalworking equipment (MOO)?

I think first, the main reason is that the machine building plants that manufacture the main types of equipment are not providing their product with a set of spare assemblies and parts required for operation and repair of the equipment. Moreover, the volumes of specialized production of tools and industrial equipment are extremely inadequate. In short, both machine building and non-machine building plants are forced to manufacture a considerable part of interchangeable and repair assemblies and parts, tools and equipment through their own efforts in their own auxiliary shops. But this production, usually being outside the skills of specialized machine building, also causes an insufficient level of quality, low reliability and expensiveness of the product.

Here is another important circumstance. I would say that there is usually no individual tailoring shop—medium and small enterprises that manufacture individual types of non-mass and unique equipment from individual orders of clients—associations, enterprises, scientific research institutes and design offices—in Soviet machine building. And this means that these clients are forced to fabricate this equipment through their own efforts in their own auxiliary shops. And, as one can easily guess, supplementary machine tools are needed for this, which only contributes to formulation of a numerous stock of metalworking equipment, operated outside machine building.

It is obvious that organization of output—along with the appropriate equipment—of a set of parts and assemblies in machine-building sectors, which is adequate for normal operation, repair and modernization of equipment, and also the necessary set of tools and industrial equipment is becoming an urgent problem. It is just as important to form a network of small and medium enterprises that manufacture equipment from individual orders.

The next timely problem is improving the technological structure of the production apparatus of machine building. Extremely metal-, fund- and labor-intensive technology of cutting still predominates in the USSR and the technique of plastic deformation is being used relatively little. Thus, there are 16 units of forge-press equipment per 100 metal-cutting machine tools in the USSR, while there are 24 units in the United States.

Soviet industry is still lagging extremely far behind equipment that provides high quality of manufactured technology. There are 31 grinders in the USSR per 100 lathes and turret lathes, while there are 66 per 100 in the United States, and there are 4.5 and 15 dressing and finishing tools, respectively. Moreover, it is obvious that any "quality assurance systems" and State acceptance will not yield the desired effect if there is a shortage of equipment that permits high quality of the manufactured equipment.

Characterizing the industrial structure of the production apparatus of machine building, one should touch on yet another problem. We are talking about the need to provide not only a high technical level and implementation of the capabilities of NTR [scientific and technical revolution], but high economy as well.

Let me explain this with an example. Cutting various types of rods and bars (for shafts, fasteners and so on) and cutting outside and inside threads occupy an important place among metalworking operations. These mass operations can be fulfilled on complicated and expensive lathes and turret lathes with current technology. At the same time, there are considerably simpler and less expensive cut-off and also screw-cutting and nut-tapping machine tools for these operations.

The use of the latter in no way inflicts a loss on the scientific and technical level of production. Of course, one can shoot sparrows with both catapults and with high-speed automatic weapons. But it is felt that catapults are preferable even in the age of the scientific and technical revolution.

Nevertheless, there were 8.9 cut-off machine tools and 2.7 screw-cutting and nut-tapping machine tools per 100 lathes and turret lathes until recently in the production apparatus of USSR machine building. These figures are 46.2 and 10.9, respectively, in the United States. Alas, there is no need for our comment.

Talking about the problems of Soviet machine building, one can not help but recall the low level of specialization and cooperation. The plants that manufacture one or another type of equipment usually produce all assemblies and parts themselves "for themselves." I feel that there is essentially no network of enterprises (medium and small) of intersector functional specialization; an "infrastructure" of machine building should persistently be created only during the 12th and 13th Five-Year plans. This network can be created, but to do this, the mentioned multimillion stock of equipment, which has until now been used outside machine building, must be used through the efforts of USSR Gosplan and the

territorial planning organizations and through the efforts of the ministries and departments. This is the most important prerequisite for rapid development of new equipment.

It goes without saying that the most important problem is to improve the use of the stock of metalworking equipment on hand and to increase sharply the return from a unit of stock.

And, finally, there is an insufficient level of quality of many types of equipment produced in the USSR. Let us say, the proportion of each unit of equipment is exceptionally high. It is no accident that our machine tools are distinguished by increased metal consumption—sheet steel, thin-sheet and cold-rolled metal are used in them comparatively little and the specific proportion of casting is unjustifiably high. And as a result of all this, the competitiveness of Soviet machine tools on foreign markets is reduced, the possibility of equipment export is reduced and the USSR is almost the only industrially developed country which has a large, but unfortunately a growing passive balance in export and import of equipment.

6521

UDC 658.563

Importance of Tools Discussed

18610194 Moscow MASHINOSTROITEL in Russian No 3, Mar 88 pp 10-11

[Article by Deputy Chairman, Bashkir oblast Board of VNTO [All-Union S&T Society] of Machine Builders, A.N. Negovskiy: "Tools: Foundation of Preparation of Production", under the "In S&T Society" rubric]

[Text] The 27th CPSU Congress set the most important goal for machine builders: to master production of new types and generations of machines, machine tools and other equipment that must ensure a sharp increase in productivity of social labor. What does the success in solving this problem mostly depend on? Probably, every machine builder's answer will be unambiguous: on availability of technological jigs and fixtures and tools, i.e. on the status of tool making.

What is the current status thereof at enterprises in our Republic? Unfortunately, a lot of collectives do not have anything to brag about. Here, for instance, the Blagoveeshchensk Fittings Plant. There is virtually no tool department here, just a small toolroom. It is crammed, and its equipment is far from state-of-the-art. Is it then anybody's surprise that new capacity and advanced technological processes have not been mastered for a long time? Situation at a number of other enterprises is the same: inadequate production area, obsolete equipment and lack of skilled personnel. Can one talk seriously about mastering high technical level products if tooling and fixtures for making it are manufactured using obsolete machine tools and not by the best specialists at that?

The tendency of installing new equipment first in the so-called main and last in ancillary (tool) production is widespread. Maybe this is why one can see most morally and physically obsolete equipment in tool production.

Of course, there are a lot of collectives where the management and engineering departments take the right stand on this issue and use every effort to develop their own tooling base. If one names large enterprises, sceptics wiil say immediately that one cannot compare capabilities of large enterprises to those of others. We shall therefore use the "Ufaselmash" plant as an example. Here, the tooling department is an object both Director and Chief Engineer take special care of. The department operates two full shifts and has modern equipment, such as a jig grinder and an EDM. This approach makes it possible for the department to not only fully support preparation of its own production, but also make fixtures and tooling for other plants in the industry within the framework of industry cooperation.

Ufa PO [production association] imeni Kirov has a decent tooling base too. Not only they make here necessary tooling for in-plant use, but also look for and find ways to prolong its service life. In order to do this, they have successfully mastered state-of-the-art technology for restoration and hardening of worn-out tools.

Taking into account experience of the best enterprises, the Republic S&T community pays serious attention to improving technological and tooling preparation of production. During the 11th Five-Year Plan scientists and professionals developed a special integrated program that formed the basis for compiling plans for improving technological and tooling preparation of production at machine building plants. The plants are given helpful methodological materials. As a result, the use of typical technological processes has broadened, and coefficient of material utilization has increased. According to professionals' estimates, overall savings due to implementation of elements of the unified system of technological preparation of production at machine building enterprises in the last three years have exceeded R9 million.

However, there are a lot of enterprises where the level of technological and tooling preparation of production does not meet the requirements of acceleration of S&T progress. And the problem is not just a weak technical base, but also organizational helplessness. Team forms of organization of work have not been implemented in all places yet, and production and produciton preparation departments do not pay enough attention to problems of computer-aided design of tooling and fixtures, planning technological processes and leading expansion, planning

and management of tool making. So far, self-accounting [khozraschet] economic incentives for improving technological and tooling preparation of production and reducing the time necessary for mastering new equipment and technology while at the same time saving all resources, including technological jigs and fixtures, are used very little. The use of systems for limiting tool consumption that have proven to be good at advanced plants, and experience in using material incentives for reducing tool consumption is totally inadequate.

It is absolutely clear that one cannot make a good-quality part if one does not have good instruments and fixtures that are in working order. Meanwhile, some enterprises, for instance, the Ufa Shape Rolling Plant, still have difficulties in repairing and calibrating fixed-limit instruments and tools, such as snap and plug gauges and master cams. This happens because there has been no here time to create a metrological department in the first place.

On the other hand, because there is no centralized supply of typical cutting tools, the problem of improving the quality thereof turns on a serious problem of "natural economy". Bashglavsnab does not meet demand for tools, such as drills, taps, threading dies etc., so a lot of enterprises are forced to make these tools themselves, thus taking some of their resources away from manufacturing specialized tooling and fixtures. Besides, "Ufaselmash" and the Shape Rolling Plant, PO imeni Kirov and some other enterprises in the Republic constantly experience shortage of new advanced grades of hard alloys and materials for machining thereof, high-speed and sectional instruments with multifaceted carbide inserts, tools with wear-resistant inserts and technological jigs and fixtures.

There is not enough specialized automatic high-efficiency equipment for tool building, including equipment with microprocessors, that makes it possible to radically improve tool quality and precision and increase productivity in production preparation departments.

All these problems were discussed at the Practical Scientific Conference on Production Intensification by Improving Preparation Thereof, organized last year in Ufa by Bashkir oblast Board of VNTO of Machine Builders, Bashkir Branch of AN SSSR [USSR Academy of Sciences] Scientific Council on Economic Problems of S&T Progress and other Republic organizations.

Professionals from machine building enterprises, scientific research institutes, design bureau, VUZs of the Republic and other regions of the country made a lot of valuable suggestions on improving the structure of production preparation management, for instance, on creating in Ufa (at a machine builidng enterprise) an office that would service all machine building plants (and first of all small ones) in the city by renting out universal assembly fixtures (UAF). It was also suggested to create such offices in other large Baskhirian machine builidng centers, taking into account operating experience of the Ufa office.

Scientists and professionals suggested that Republic planning bodies and machine building Ministries consider creation of a large specialized production facility that would manufacture nonstandard automation and mechanization devices for all Republic enterprises (again, first of all for small enterprises that cannot organize their own production of these special jigs and fixtures), using standardized (unified) engineering documentation. The suggestion to implement unified provisions on self-accounting stimulation of collectives of production departments and shops and individual employees for improving the quality and reliability of tools, jigs and fixtures and realizing savings in manufacturing thereof also merits consideration.

Recommendations of Conference participants should facilitate leading development of capacity at production and production preparation departments and therefore reduction of time for mastering the manufacturing of new products in the machine building industry. Sufficient amount of time has elapsed after the Conference, but very little has been done so far in order to strengthen this most important area of the Republic machine building industry. The situation with centralized supplies of standard cutting tools to enterprises has not improved yet, and no practical measures have been taken either in organizing UAF renting or in creating a specialized production facility for manufacturing nonstandard automation and mechanization devices. But time presses. To accelerate the solution of these problems is an urgent requirement of the perestroyka process in the machine building industry.

12770

Automatic Balancing Devices for Mechanized Hand Tool

18610418a Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 4, Apr 88 pp 17-18

[Article by V.P. Nesterenko and S.L. Katanukhina, candidates of technical sciences, and S.N. Kladiyev, B.A. Pevnev, and A.M. Furmanov, engineers]

[Text] Hand grinders are used as the principal mechanized tool for grinding welded joints in the manufacture of motor vehicle bodies. They vibrate a great deal both with and without a load. The main source of vibration in grinders is a routine variation in the grinding wheel's unbalance, which occurs chiefly because of variance in the parameters of grinding wheels during their manufacture, as well as because of nonuniform wear when they

are worked with. Prior balancing a single time of a grinder's rotor and the arbors on which the abrasive wheels are placed does not produce a positive result for a steady reduction in vibration, since constant variation of the grinding wheel's unbalance occurs in the process of the grinder's operation.

Automatic balancing is one effective method of combating the vibration of hand grinders. It is accomplished as follows. A metal hollow ring inside of which freely moving balls are placed is fitted on the shaft of the grinder's spindle coaxial with its axis of rotation. The balancing process is implemented only at a rotor rotational speed higher than the grinder's resonance frequency. The natural resonance frequency of a hand grinder, the elastic element for which is the operator's hands, is considerably lower than the rotor's nominal rotational speed. Under the influence of centrifugal forces the balls automatically occupy positions inside the hollow ring with which compensation of the effect of the grinding wheel's unbalance occurs and, accordingly, a reduction of the vibration of the grinder itself.

The use of automatic balancing devices on hand grinders reduces the risk of the origin of vibration-related diseases in operators and reduces worker fatigue. The quality of machined surfaces improves on account of a reduction in vibration, as well as of the more uniform wear of an abrasive tool with an automatic balancer.

Research tests were conducted in 1987 at the Volga Motor Vehicle Plant on an automatic balancing device (ABU) developed by the department of theoretical mechanics of Tomsk Polytechnical Institute in conjunction with the AvtoVAZ PO [Production Association] and designed for reducing the harmful dynamic loads originating in the process of a hand grinder's operation from routine variation of the unbalance of abrasive heads. Tests were conducted on a quantity-produced model 707 0 602 222 004 hand grinder made by the Volga Motor Vehicle Plant. These grinders are furnished with a three-phase asynchronous motor with a short-circuited rotor and are powered from a 135 V, 200 Hz line. The use of an elevated frequency for the power line makes it possible to reduce the grinder's overall size and weight while maintaining high net power. The maximum power of a grinder weighing 5.6 kg is 1 kW, and the spindle's rotational speed under a load is 5800 r.p.m.

These grinders are used for grinding the doors and fenders of rough bodies of all models of VAZ [Volga Motor Vehicle Plant] vehicles by means of soft grinding heads having a maximum diameter of 100 mm, in the form of a set of cotton disks on a special arbor with a ring-shaped fabric-based abrasive belt put on them.

Under actual production conditions hand grinders operate under conditions of being repeatedly shut on and off for short durations. Tests were conducted with the constant application of a load under more rigorous conditions from the viewpoint of the effect of vibration on a person.

The device developed belongs to the category of mechanical ABUs of the passive type. Simple in design, it effectively eliminates the vibration of grinders. The design of the automatic balancing device is shown in fig 1. The ABU's principal overall dimension is the outside diameter of the hollow ring, which basically determines the device's effectiveness and its weight. Restriction of the hollow ring's height is an additional requirement for an ABU. This is due to the fact that the plane of action of the correcting masses must be maximum close to the plane of action of possible unbalance. The amount of momentary unbalance of the grinder's rotating parts with the automatic balancer operating is reduced at the same time. The hollow ring's inside diameter and its height, taking into account the wall thickness ensuring sufficient rigidity for the hollow ring's construction, restrict the maximum size of the correcting bodies partly filling the hollow ring. Balls from standard bearings are used as the correcting bodies in this instance. The amount that the centers of mass of the correcting bodies are offset relative to the system's axis of rotation, as well as the number of bodies, determine the device's capacity, which must be sufficient to eliminate the grinding head's unbalance. E_1 is the ABU's capacity with an odd number of balls, E_2 is the ABU's capacity with an even number of balls; m is the weight of a ball; α is the angle between the radii passing through the centers of two touching balls; R is the radius of the hollow ring's inside surface in cross section; and r is the radius of a ball.

The number of balls in the hollow ring is determined from formulas (1) and (2). The minimum number of balls in an ABU for the automatic balancing process must be not less than two, and the maximum, so that balls touching in the hollow ring do not occupy more than half its space in terms of its circumference, since otherwise the balls will partly counteract the net effects of one another when the system rotates. Four balls are used in the device developed.

The following requirements were fulfilled in making the ABU's hollow ring in order to improve the precision of automatic balancing. First, the eccentricity of the hollow ring's inside surface relative to the grinder's shaft was reduced to a minimum by executing this surface, as well as the surface for seating the hollow ring on the shaft, with one set-up. The play of the hollow ring's inside surface relative to the axis passing through the shaft's center does not exceed 10 micrometers. Second, the roughness and wear of the hollow ring's inside surface were reduced to a maximum by grinding it and hardening it to a hardness equal to the hardness of the balls. Rolling friction is thereby minimal. Third, agreement of the natural frequency of the ball's vibrations relative to the hollow ring in the axial plane with the grinder spindle's rotational speed was ensured. For this the radii of the hollow ring's inside surface in the axial and cross sections must satisfy a relationship where ρ is the radius of the hollow ring's inside surface in the axial section.

The excitation of transverse vibrations of the balls is conducive to placing them more accurately and quickly

in stable positions when the system accelerates. The use of an outer race from a standard spherical bearing as a "raceway" for the balls satisfies relationship (4) sufficiently closely. The race from a bearing is placed with a tight fit inside the hollow ring. The precision of the race's placement relative to the grinder's shaft is ensured at the same time. The operations of hardening the inside surface of the hollow ring and of subsequent finish grinding are eliminated in this design.

In stable positions the balls are stationary relative to the rotating hollow ring. Therefore, thin grease is placed on the hollow ring's walls for the purpose of shortening the time of the transient process of putting the balls in a stationary position.

The maximum weight of the device developed is 420 g, or 7.5 percent of the grinder's weight. It is possible to reduce the ABU's weight by fabricating the hollow ring's side wall directly with the required profile of the raceway. The fabrication process for the device becomes complicated when this is done.

A VShchV-003 noise and vibration meter was used for measuring vibration parameters. Tests of the grinder were conducted on a special bench with a turntable decoupled from the drive, in accordance with the specifications used at VAZ. The values of vibration rates in the directions indicated in fig 2 were measured in the tests by means of a transducer screwed to the grinder's handle. The results of the measurements are presented in the spectrograms (fig 3a and b).

It is obvious from the spectrograms that the vibration level for the fundamental frequency (63 to 125 Hz) is reduced by 7 to 10 dB as the result of using an ABU on a grinder and maximum vibration levels of not higher than 101 to 102 dB are guaranteed, which is 5 to 7 dB lower than the health standards according to GOST [All-Union State Standard] 17770-86.

8831

Modernization of Lathes Increases Productivity

18610418c Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 4, Apr 88 pp 37-38

[Article by V.P. Zakharov, candidate of technical sciences, and V.P. Manunin, engineer]

[Text] The model RT-102 and RT-103 lathes have been modernized at the Volga branch of VNIIASh [All-Union Scientific Research Institute of Abrasives and Grinding] with the combining of the machining by grinding of the seating hole and outside-diameter surface of grinding wheels. Eight modifications have been developed for modernizing lathes for various purposes, three lathes have been made and placed into service at the Volga Abrasives Production Association (VAPO), and two more lathes are at the development stage. The Voronezh Machine Tool Plant imeni the 50th Anniversary of the Komsomol is to supply 16 sets of modernized subassemblies for the RT-103 and RT-102 lathes.

The combined machining and the lathes' modernization consist in the following: A wheelhead for machining the seating hole of grinding wheels is installed on the lathe's carriage in place of the tool head. A second carriage group of units (supporting pedestal, saddle, carriage and wheelhead) for machining the outside-diameter surface of grinding wheels is installed parallel to the saddle. A stack of wheels 150 to 360 mm high (depending on the lathe's modification) is loaded onto the lathe by means of a special pivoting lifting device and this stack is centered according to the outside diameter by using a radial chaser device and is lifted until the headstock spindle's axis of rotation and the hole axis of the stack of grinding wheels coincide. The stack of wheels is retained at its ends against the case of a radial bearing on a support arm and is rotated by the main drive with the radial chaser device lowered. The seating hole is machined with model FATs-175 or FATs-110 (TU [Specifications] 2-037-445-84) diamond wheels and the outside-diameter surface with special roughing-out grinding wheels 150 to 350 mm in diameter (TU 2-036-735-87).

The following is to be noted after three years of use of the first modernized lathes: The modernized lathes have increased productivity by a factor of 1.6 to 1.8. They have reduced twofold the labor intensiveness of the loading and unloading operations for items in machining. They have made possible precision machining with a 70- to 80-percent yield of class AA wheels (with respect to the precision of the seating hole and the alignment of its axis). The reliability of the lathe's operation has been improved because of the elimination of the 3-jaw chuck, which requires systematic repair.

However, the use of the modernized lathes and their broadening conditions of application have also revealed their shortcomings: First, the lathes do not make possible a 100-percent yield of class AA wheels because of the insufficient rigidity of the SPID [machine tool - accessory - tool - part] system, including of the support arm for the radial bearing. Second, the radial bearing assembly has been found to be insufficiently reliable. The labyrinth seal has proven to be insufficiently reliable for keeping out abrasive dust. The radial bearing used does not withstand an axial load and its service life is shortened to three to six months under two-shift operation. Third, a further increase in mechanization and automation of the production process and in step-by-step checking of machining precision is required.

The correctness of the conclusions of a study of the precision of locating in terms of the outside diameter was

confirmed at VAPO for grinding wheels made of synthetic corundum materials. The wheels of the Zaporozhye Abrasives Production Association are more subject to deformation in firing and it is necessary to make a corrective adjustment of the radial chaser device for centering the stack of wheels.

The Volga branch of VNIIASh has developed technical solutions for eliminating these shortcomings: A new design for the supporting arm with the fastening of it to the bed of the headstock, which will increase rigidity and machining precision. A new design for the radial bearing unit with the addition of a thrust bearing and the creation of overpressure in the bearing case. The feasibility is being studied of a continuous operation for the machined stack of wheels with the goal of possibly building lathes into a mechanized line, and the feasibility of automating the lathe and of automatic step-by-step checking of the precision of the seating hole. The development of a mechanism for compensating an error in the shape of the outside-diameter surface is planned.

The use of modernized lathes and the new technical solutions for improving them are providing grounds for further expansion of the placing of modernized model RT-102 and RT-103 lathes into service. For example, plans are being made to place into service at the Ilich Abrasives Plant NPO [Scientific Production Association] (Leningrad) and ChAPO [Chelyabinsk Abrasives Production Association] (Chelyabinsk) the modernized model RT-103 lathe for machining the seating hole and outside-diameter surface of 500 to 600 mm and 750 to 1000 mm diameter grinding wheels, which has been placed into service at the Volga Abrasives Production Association and the Zaporozhye Abrasives Production Association.

8831

School of Mechanics Created at Yerevan State University

18610189d Moscow KOMMUNIST in Russian No 76, Mar 88 p 2

[Excerpt] A new scientific and educational division, a school of mechanics, has been created at Yerevan State University. This school, which is the only one of its kind in the country, separated from the school of mathematics and mechanics which has been in operation since 1959. Graduates of the new school will receive the specialties of mechanic and applied mathematician.

Professor Vladimir Sarkisyan, corresponding member of the Armenian Academy of Sciences and dean of the new school, told an Armenpress correspondent that the latest production and technological processes are closely linked with promising directions of research in mechanics and machine building, as are complex machines of new generations. Ultrahigh, high and ultralow pressures and temperatures, magnetic fields, ultrasound, infrared radiation, vacuum, microwave frequencies and other physical phenomena are widely employed in modern technology. Employment of so-called composite materials is one of the promising directions of modern machine building.

A new direction, structural mechanics, has been advanced in mechanics with the aid of the great capabilities of mathematics and computer technology. Its main objective is to develop materials with prescribed physical-mathematical properties which operate reliably in various conditions. The use of these materials in the economy can yield a great economic benefit.

02291

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Problems of Obtaining Intermediate Products in GPS

18610198 Moscow VESTNIK MASHINOSTROYENIYA in Russian No 3, Mar 88 pp 36-40

[Article by Yu.A. Bocharov, doctor of technical sciences]

[Excerpts] The problems of accelerating the scientific technological progress in machine tool building, formulated in the decisions of the 27th congress of the party, are directly connected to the improvement in the production of intermediate products. An essential reduction in materials, power and labor costs can be achieved primarily by improving the technological processes, and by a maximum likeness to the shape and dimensions of the intermediate products to the finished parts and to a reduction in the volume and laboriousness of further machining. An increase of 2.3-2.5-fold in labor productivity, a reduction in the national requirements for metal by almost half and reductions in power costs can be achieved by further automation of production—by creating robotized technological complexes (RTK) and flexible production systems (GPS) in the production of intermediate products.

So far, there are still a small number of examples in the creating of GPS in producing intermediate products as compared to processing by machining. There is not enough production of forging-stamping, casting and welding equipment with numerical control, especially for forming intermediate products in a not state.

Machine-building specialists in the USSR and abroad have manifested great interest in the development and use of presses, hammers, casting machines and other NC equipment, especially in casting, sheet-stamping, forging and hot die forging production, and the use of powder and laser technologies in creating the flexible production of intermediate products.

In this direction considerable progress has been made by the development of robot equipment, especially electron-computer equipment. It became possible to use computers to simulate and design technological processes for designing and manufacturing dies and molds, and controlling the operation of equipment. The achievements and problems in this area must be taken into account in developing the GPS.

Under intermediate product conditions, automatic adjustment is frequently restricted by insufficient NC equipment and robots capable of operating hot casting, press die forging and thermal shops, as well as cutting, straightening and finishing flexible modules. It is also necessary to develop packets of application programs for their operation. At the present stage of the development of the GPS, it appears that for intermediate products where this is economically justified, it is sound practice to have mechanized readjustment, tool replacement and set-ups of the initial intermediate products.

In all cases, when the GPS is being developed, it is most effective if it is of a comprehensive nature which combines all the subsystems: input monitoring and preparing the initial material, the intermediate product and the finishing processing, assembling and packing, with the respective transport and information subsystems which are interrelated. These are: automatic design of technological processes, organizational-economic production control, operational-dispatcher control, control of technological processes and equipment, diagnosing and correcting their states.

Intermediate production using the GPS is related to the final production and assembly and can permeate them. It must be flexible, i.e., provide for obtaining intermediate products in any quantity at any time as required by the finishing process and assembly. The efficient organization of production of the intermediate products using the GPS is of extremely great importance. It is known that up to 70-80 percent of the production of many machine-made products is the cost of the material. Meanwhile, due to the inefficiency of intermediate products in our country, up to 25 percent of the metal used in enterprises of only nine machinebuilding industries goes to waste, half of which goes to shavings when allowances are removed by cutting [1]. In the United States, for example, some 14.5 million tons are wasted in cuttings.

The development of the flexible production of intermediate products was made possible by the creation of NC technological machines, robot equipment, microprocessing equipment, group methods in technology, SAPRK [Automatic Design Systems Complexes] and the corresponding training of cadres etc. Meanwhile these possibilities are far from being fully utilized. In the structure of the output of metal-working equipment for the GPS, as before, metal-cutting RTK and GPM [Flexible Machine Production] prevail. There are units of RTK and GPM for sheet stamping, but the volumes of output of casting and forge- stamping equipment for making intermediate products do not satisfy industrial requirements. Making three-dimensional intermediate products by forging and hot die forging has its difficulties which are related to the special features of the processes:

instability of the mechanical properties, volume, geometry and temperature of the initial material as well as the instability of the kinematic force and power parameters of the forge and stamping machines which requires constant monitoring of the condition of the machines as well as of the technological process;

the inconstancy of the intermediate geometrical forms of die forged articles requires the use of complicated transporting and positioning;

the high forging temperature necessary for most metals and alloys requires special devices to protect the machines and the means of automation and control;

the narrow range of forging temperatures and the multitransitional technology of die stamping require higher deformation speeds which is due to high dynamic loads and vibrations of machine components and the environment;

difficulties in attaching dies to the movable parts of hot die forging, screw presses and especially hammers;

hot die forging technically requires the synchronization of the operation of a number of production machines that have various parameters of productivity, accuracy, level of automation etc.;

the development of equipment and processes of die forging, and the simulation of the dynamic interaction between the machine and the process still have not reached the reliability level, sufficient for use in GPM systems for hot die forging.

The GPM structure for processing by pressure consists of the following subsystems: a forming machine (with drive and mechanical subsystems), a working tool (flat or complicated dies), the intermediate product being processed, a mechanism for changing the tool, a device to transport and position the intermediate tool, a microprocessor for monitoring and diagnosing the parameters of all the GPM subsystems, as well as input and output parameters of the material being worked. Heating systems can be built in or be independent.

The flexible technological robot complex consists of a program controlled forge-stamping machine, mechanisms for replacing the tools, transporting and positioning the intermediate product, controlled by a microprocessor. The functions of the mechanism for moving and positioning the intermediate product, as well as changing the tool which must be done by a program-controlled robot, cannot be fully automated at present in complicated die forging RTK, and are usually done by the

operator. GPK, as well as the RTK can be used independently or as part of more complex systems. The structure of the design and development systems of the GPM and the RTK can be done conveniently on the basis of morphological classifiers.

Morphological Classification Table 1 shows the following components and criteria: geometry of the forged intermediate product—asymmetrical, simple, three-dimensional, and complicated; initial material—bar, profile, pipe, casting, metal powder, and size of lot, pieces; process—forging, open stamping, closed stamping, extrusion, radial reduction, precision stamping, compacting, and isothermal drop forging; tools—flat dies, rolling impression dies, dies, rollers; machines—water gage, hydraulic press, crank press, percussion power press, hammer, high speed machine, radial reduction machine, mechanism for moving and positioning, hook gage, hook conveyer, drum, manipulator, rotary horizontal, rotary vertical, chain conveyer, pallet, and cassette; programmed control—rigid, adaptive, and intelligent.

To obtain intermediate die forging products, it is efficient to use forging methods which, by means of simple, universal and rolling impression dies, can produce on machines with a kinematically free movement of the tool such as hydraulic presses and hammers. The small forgings weighing up to 20 kg, it is advisable to forge with pneumatic hammers for which systems of programed control are being developed [4, 5]. For large forgings it is most promising to use forging complexes based on hydraulic presses. It is necessary to organize, as soon as possible, such complexes for axially-symmetrical forgings with an elongated axle. A progressive method and equipment for plastic shape changes by a combination of interactions, for example, drop forging with torsion, is being assimilated slowly. Such methods have great technological flexibility and can be used widely to produce axially-symmetrical intermediate products in the GPS. Especially acute is the problem of developing methods for die forging and NC equipment for GPS. In this five-year plan period, the planned assimilation of the GPM on the bases of 40MN crank presses with limited strokes of the slide block is intended for large-series production and mass production due to the necessity of readjusting the equipment and the high cost of the dies.

NC equipment for hot die forging of intermediate products is not being produced for the overwhelming majority of machinebuilding sectors with small-series and series production. The solution to this problem can be facilitated by the development of percussion power presses for die forging in open or closed dies with detachable female dies, hydraulic NC die forging hammers and steam-air NC die forging hammers [5-7]. Especially promising for the GPS are methods for making die forgings of powder materials that have the required flexibility and reduces the volume of machining. The lack of the types of NC equipment required prevents the wide use of this progressive technology.

Experimental prototypes of hydraulic vibration presses and the NC system for them are being developed. Regrettably, such presses are not being produced by the machine tool industry. The considered examples indicate that the possibilities are still not being utilized which could facilitate an increase in the importance of plastic shaping in assimilating the GPS by the machine-building sectors of the industry. Producing the GPS, oriented only toward machine cutting, predicates the inefficient consumption of materials, greater laboriousness of machinebuilding products and lower productivity of social labor.

Table 2 shows: the processes used—forging, open die forging, closed die forging, extrusion, precision die forging, and isothermal die forging; equipment flexibility—design, technological, range of technological forces, energy of deformation MJ, possibility of energy summation, range of tool speed, and maximum frequency of cycles (n, 1/min).

Along with modernizing the forging equipment, related to the use of NC, robots and diagnostic systems, it is necessary to develop shaping machines especially intended for operation in the GPS as follows: those that have broad structural and technological flexibility, able to combine the methods of forging with die forging, casting and die forming, casting, die forming and welding etc.

It is especially necessary to dwell on the importance of rotor technology for the GPS. This is a progressive organizational-technological method, developed in our country, which combines the times of work operation and transportation. It has already proven its high efficiency in mass production and large series readjustable production facilities. It is based on the comprehensive technology of combining the most efficient intermediate product preparation (casting, die forging, welding) processes with the finishing (cutting, grinding) processes and assembly.

The solution to the rapid readjustment problem by rotary conveyer systems creates premises for using them also in small series production for articles of comparatively small mass and size.

The wide use of laser technology to cut and weld blanks from sheet materials is being hindered by the lack of technological equipment. The output should be accelerated of these progressive machines which have anextremely high design and technological flexibility, i.e., have wide possibilities for changing all required technological parameters.

Most intermediate product shops have small series and large product list production facilities which creates difficulties in using progressive methods for shaping, mechanization and automation. At the same time, precisely these small series and large product list production facilities most of all need to change to GPS. The problem

can be solved by using methods of group technology, applying widely universal or rapidly readjustable group group equipment. Such equipment is developed by classifying parts and intermediate products into groups and using group technological processes. The organization of group technology in producing intermediate products, the development and use of NC equipment and robot-manipulators, controlled by microprocessors, creates a reliable basis for using GPS and producing optimal intermediate products in small series and series production facilities.

Conclusions

1. It is sound practice to accelerate the design and industrial manufacture of new intelligent equipment for the GPS: flexible forging and casting modules with adaptive programed control, and diagnostic systems for manufacturing plastic and casting shaping a wide product list of the forging, casting and die forging, and casting intermediate products in small lots with automatic readjustment. The module must have individual, static, shock, vibration and combination affects on the material being processed, microprocessor programed adaptive control, automatic diagnostics and stabilization of equipment parameters and of the technological process.

The working conception must be directed toward the integration of intelligent technological machines programed by robots and with microprocessor control on the basis of merging these three components of flexible automation into one intelligent robot-producer intended to operate in the GPS.

2. In parallel with the development of intelligent robot-producers, it is sound practice to develop NC systems for series manufactured casting machines, presses and hammers.

3. Taking into account the importance of developing software for the production processes of intermediate products in the GPS, it is sound practice to organize a state data file for the GPS, GPM and RTK software, to stimulate and coordinate packets of application programs for the analysis and design of technological processes for producing intermediate products by pressure, casting or welding.

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02291

The "Unicon" CNC

18610190e Moscow SOVIET EXPORT in English No 1, Jan-Feb 88 p 28

[Under the rubric "News in Science, Engineering, and the Economy"]

[Text] This is a new numerical control system for metal-cutting machine tools built by engineers at the Novosibirsk Electrical Engineering Institute and the Tyazhstankogidropress Production Amalgamation. The system offers machining capabilities quite as good as those provided by the latest numerical controls banned for export to the USSR by the industrialized capitalist countries. The "Unicon" CNC will make a lathe cut a segmental spherical portion or any configuration on a cylinder. When tested, the system controlled the process of machining an eccentric with a sinusoidal groove. The system is going into production at Soviet engineering plants.

02291

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New Products of Machine Building Industry Reviewed

18610401a Moscow VESTNIK MASHINOSTROYENIYA in Russian No 3, Mar 88 pp 74-75

[Article by Engineer A.V. Sidorova: "Review of Achievements of Soviet Machine Building Industry" under the "Acceleration is National Business" rubric]

[Text] A jubilee Show "Achievements of the Machine Building Industry on the Eve of the 70th Anniversary of the Great October" took place in No 1 Pavillion of

Intersectorial Shows at the VDNKh SSSR [USSR Exhibition of Achievements in National Economy]. The Show was on from November, 1987, through February, 1988. The exposition demonstrated the role and importance of the domestic machine building industry in all spheres of the national economy, the dynamics of its development during the Soviet power years and its contribution to implementation of decisions of the 27th CPSU Congress and subsequent Plenums of the CPSU Central Committee. Especially urgent are goals of tremendous economic and political significance: in a short period of time modernize the Soviet machine building industry and reorient it toward manufacturing high technical level systems and equipment complexes for all sectors of the socialist economy.

The Ivanovo Machine Tool Building Production Association imeni the 50th Anniversary of the Great October developed multipurpose machine tools and flexible manufacturing modules IS800 for combined machining of base members made of ferrous and nonferrous metals. Among main operations are drilling holes 3 to 45 mm in diameter, boring holes up to 315 mm in diameter, contour milling and grinding and thread cutting and milling. Among ancillary operations are tool change, workpiece change, dimensional control, inspection of broken tools, correction of errors in the measuring head set-up, dressing of grinding wheels, control of tool longevity and replacement of tools with duplicate ones, control of cutting conditions, chip removal from the cutting zone to a container and cleaning SOZh [lubricating and cooling fluids] from particles of abrasive material.

At the Show, a CNC hydraulic press for manufacturing synthetic superhard materials (diamond and borazone), including monocrystals, polycrystals and powders and composites based on these materials and used for sintering of diamond-hard-alloy bits for various cutting tools, was presented. Its application makes it possible to increase productivity of machining, improve the quality of synthesized products and develop anew in principle technology. Its main technical parameters are as follows: nominal force 50 MN; height 1,100 mm; pressure buildup time 2.5-250 min; time under pressure 3-3,000 min; pressure releaes time 120-4,000 s; heating power 5-40 kW; mass 54.5 t.

The VISP [not further identified] developed a semiautomatic CNC machine model 3201P for plasma spraying of single- and two-component powder cermet materials onto outside surfaces of cylindrical parts and parts with complex configuration, in order to give the parts certain properties (wear resistance, corrosion ressitance etc.) and to restore worn-out parts. The length and diameter of sprayed parts are 1,600 and 500 mm, respectively; part mass is up to 50 kg; plasmotron speed is 0.16-1400 mm/s along and 0.1-50 mm/s perpendicular to the part axis; power consumption does not exceed 110 kW; overall dimensions do not exceed 4,850 x 4,850 x 2,450 mm. The design ensures reliable personnel and environment protection against noise, dust and aerosoles.

The VNIIavtogenmash [All-Union Scientific Research Institute of Oxyacetylene Machine Building] and the Barnaul Equipment-Mechanical Plant developed a gas-flame machine for depositing powders of self-fluxing and composite materials and ceramics with melting point not exceeding 2,050 oC onto metal surfaces of crankshafts, connecting rods and cylinder heads and blocks of automotive and tractor engines and general -use machine building parts. The machine is used for parts restoration and corrosion protection.

The machine makes it possible to deposit coatings onto surfaces in any spatial attitude; mechanize the coating process; noninertially control powder supply; and perform stepless (from the control panel) and stepwise (by changing gun feeder and the tip) control of deposition rate. Maximum spraying rate: ceramics (aluminum oxide) - 2.2 kg/hr, self-fluxing powder - 12 kg/hr, and Cu-Al alloy powder - 12 kg/hr; gun dimensions 250 x 150 x 85 mm; machine dimensions 660 x 660 x 300 mm; gun and complete machine mass 0.9 and 24 kg, respectively.

Hardening technologies (ion-plasma, laser, pulse and explosion treatment) make it possible to efficiently improve the quality of products made of traditional materials and perform repair and restoration at a machine installation site. Plasma deposition of an antifriction layer onto hydraulic cylinder pistons is performed with a direct action plasma arc while sidefeeding filler wire at an angle to the part surface. The process has a high deposition rate (up to 15 kg/hr), compared to gas or stick-electrode deposition and it also improves the quality of the deposited layer. Deposition rate is up to 15 kg/hr; deposited layer width and thickness are 10-50 and 2-6 mm, respectively; diameter of coated bodies of revolution exceeds 60 mm.

The Electric Welding Institute imeni Ye.O. Paton and PO [production association] "AvtoVAZ" [Volzhskiy avtomobilnyy zavod] developed an automatic machine model OB-1099M for deposition of heat-resistant alloys onto working chamfers of exhaust valves using directional crystallization in a shielding gas atmosphere. Unlike similar models, the machine uses induction rather than gas-flame heating. Machine productivity 200 parts per hour.

In order to control and ensure relaibility and precision of grinders and technological parameters of grinding, the VNIIPP [All-Union Scientific Research Institute of Bearing Industry] developed an automated system for studying automatic grinders. The system makes it possible to identify sources of noise and vibration, measure normalization of the autocorrelation and intercorrelation function, noise-discriminate a periodic signal and display measurement results on a recorder, oscillograph

or alphanumeric printer. The system can be used for acceptance testing of grinders and adjustment of technological parameters, and it can be interfaced with a control microcomputer.

NPO [scientific production association] "Rostov-NIITM" [Rostov Scientific Research Institute of Machine Building Technology] developed new tooth shapes for shredder drive gears, wherein a high carrying capacity (25 to 30 percent) gear contact zone is formed during operation. Due to this, the technology of manufacturing overdrive gears was simplified (hardening was replaced with martempering), the manufacturing accuracy was improved and noise level was reduced. Due to changes in heat treatment of gears, their thermal deformations were eliminated. As a result, the overdrive warranty period was increased from 6 to 7 years and its reliability was improved.

The Brovary Powder Metallurgy Plant imeni the 60th Anniversary of the Soviet Ukraine manufactures connecting rod spheres using powder metallurgy. This process makes it possible to simplify the design, reduce metal (approximately by 50 percent) and labor (7 operations isntead of 39) content and improve operational reliability of friction joints thanks to the lubricant in pores of the material. A sphere made of a porous powder material works under conditions typical for agricultural machinery, with 0.27 m/s relative slippage speed in the friction joint and pressure up to 0.75 MPa with lubrication.

The NIITavtoprom [Scientific Research Institute of Automotive Industry] developed a technological process of and equipment for heat treatment of cast iron parts: an automated line model 7137 for hardening camshaft cams and an automatic machine model 5552 for hardening working webs of engine valve rockers. The process is based on fast local melting of working surfaces of cast iron parts to the depth of up to 2.5 mm, caused by a high-density energy source. In the process of intense cooling of melted cast iron due to heat removal into the part body, a wear-resistant surface layer (HRC = 52-54) is formed. The use of the new process and equipment ensures high wear resistance of treated parts, frees up 11 workers and saves electric power and alloying elements (Cr, Ni, Mo, Cu and Va).

The VNIPTIkhimneftemash [All-Union Scientific Research and Design Planning Institute of Chemical and Petroleum Machine Building] and the Krasnaya Pakhra Experimental Cermet Products Manufacturing Plant developed iron-based sealing elements made by means of powder metallurgy methods. Such element works in pair with a hard alloy under the conditions of friction with lubricant. Main technical parameters: hardness not less than 180 HB; porosity not more than 5 percent; compression strength 1,000-1,100 MPa; coefficient of friction with lubricant 0.22 at 60 MPa load. The use of this material makes it possible to improve physical and mechanical properties and maximum permissible loads of sealing elements.

NPO "RostNIITM" developed the design of and technological process for manufacturing bodiless self-lubricating bearing blocks. A bushing made of a powder material is connected to a supporting metal bracket by means of projection welding in atmosphere. The welded design makes it possible to reduce bearing block mass by 50 percent. A porous bushing made of an antifriction material is soaked with a liquid lubricant and sealed. Sealing of nonworking surfaces makes it possible to make a bodiless bearing block.

Soaking a bushing made of a powder material makes it possible to ensure prolonged operation of a friction joint in the self-lubrication mode, eliminate lubricating devices, improve wear ressitance of the friction surface, eliminate maintenance during the operating period and increase productivity due to reduced maintenance time. Implementation of these bearing blocks will make it possible to save 48 tons of steel castings and free up 8 workers.

Development and implementation of new structural and composite materials makes it possible to sharply reduce power consumption and metal and labor content. For instance, the use of coal-glass plastics reinforced with fibers made of alloys and ceramics-based composite materials will make it possible to reduce mass of structures by a factor of 3 to 5 while at the same time increasing two- to fivefold their strength and longevity. The use of boron and silicon nitrides in cutting tools increases their wear resistance by a factor of 8 to 15.

Exhibits in sections "Imrpovement of Forms of Production Organization", "Solving Social Problems" and "Personnel Situation" summarize experience of leading machine building enterprises in activization of the human factor under the conditions of perestroyka, conversion to economic methods of management and implementation of achievements of S&T progress.

12770

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New Machine Building Technologies Discussed

18610401b Moscow VESTNIK MASHINOSTROYENIYA in Russian No 3, Mar 88 pp 76-78

[Article by Engineer L.I. Andreyeva: "'Progressive Machine Building Technologies' Conference (city of Olomouc, CSSR)" under the "Acceleration is National Business" rubric]

[Text] The 29th International Machine Building Fair in Brno (CSSR [Czechoslovak Socialist Republic]), September 16 through 23, 1987 (see VESTNIK MASHINOSTROYENIYA No 1, 1988), included a large S&T program, the conference of editors of technical publications being one of the items on its agenda.

The Conference subject, "Progressive Machine Building Technologies", conformed to the trend of this year's Fair.

Reporters were apprised of the work of the Machine Tool Building Association in the city of Olomouc (TST TOS, Olomouc), where a flexible automated system for machining complex-shape base members had been implemented and is successfully operated. Afterwards, Czechoslovak professionals presented papers. We offer here brief synopses of thesepapers.

"Road to an Automated Machine Building Plant" was the title of the paper presented by Engineer Z. Kozar, Director of Scientific Research Institute of Machine Building Technology and Economics (Prague).

Intensification of production, the need to radically increase labor productivity and reduce the number of employees at machine building enterprises call for further integrated development of production and reaching a new level of management, economics and technology. As far as technology is concerned, the most radical means for solving these problems is to create automated plants based on flexible overhaulable technolgical processes.

The speaker envisions transition from a today's enterprise to an automated machine building plant (AMBP) in the form of integrated modernization of existing plants which will result in sharply higher labor productivity, shorter product release time, higher equipment utilization factor, improved product quality and lower work-in-process and material and component inventories.

In the speaker's opinion, an integrated automated machine building plant should have the following features:

a) a long-term production plan;

b) the optimum range of automated workstations with the minimum possible number of operators (one operator per 8 to 10 workstations);

c) assembly automation (over 50 percent);

d automation of warehouse operations and interoperation and interdepartmental material handling, including scrap handling;

e) the use of diagnostics methods;

f) automation (at least 80 percent) of technical preparation of production (all the way from the design stage to automated storage and distribution of control programs for workstations);

g) an integrated plant management system;

h) a permanent system of imrpoving workers' skills;

i) differentiation of workstations in accordance with the intensity of operator's participation in the technological process;

j) integration of personnel functions based on automation and computer devices.

Z. Kozar emphasized that AMBP can only be created if all of the above factors are in place, so it is necessary to develop a unified AMBP concept.

Creation of AMBP is a complex and multistage problem, and it can only be solved by step-by-step implementation and gradual transition from the old to the new system.

The presence of three main factors is necessary in order to actually create AMBP: implementation of automation and computer devices, implementation of advanced technologies and personnel preparedness (the human factor).

"Progressive Technologies in the Machine Building Industry" was the subject of the paper by Engineer Ya. Poshar, Deputy Director of the same Institute. In the beginning, the speaker presented a detailed definition of the concept of progressive technology and stressed that progressiveness of a technology is not an absolute concept. Indeed, with certain simplification, any production process that results in money and resources savings can be considered progressive, however, labor content and operator's psychological stress can increase. The speaker thinks that development of the machine building industry is subject to several objective factors, which result not only in changes in traditional technologies, but also in the emergence of new methods and operations, and the problem is to find the optimum combination thereof. Among these factors the speaker named:

changing product nomenclature according to customers' demand;

the requirement to reduce power consumption and material content;

S&T progress in electronics, which facilitiates production automation;

achievements in the area of machine tool building and design of machine tool accessories, which make it possible to make complex parts in one installation while performing several operations concurrently;

application of nontraditional material processing methods etc.

The speaker proceeded to characterize the trends in the development of machine building technology in the CSSR up to the year 2000, based mainly on intensification and the drive for rational utilization of all kinds of resources.

Candidate of Technical Sciences Engineer Y.Svoboda (Scientific Research Institute of Machine Tools and Machining, Prague) devoted his paper to problems of **improving the technical level of machine tools** manufactured by the TCT concern (machine building equipment enterprises), which makes 85 percent of all machine tools for the CSSR machine building industry. Increasing production rate of machine tools while at the same time increasing the level of automation and implementing flexible technology are of utmost importance here.

In the speaker's opinion, the cutting process can only be intensified if one uses cutting tools with cutting edges made of new materials, such as hard alloys with coatings, ceramics etc. Implementation of progressive tools will make it possible to increase cutting speed to 500 to 1,000 m/min in turning and to 300 to 800 m/min in milling. Not only this means higher spindle RPMs, but also improved dynamic stability of the machine tool and shorter handling time, especially time for changing tools and accelerated movement. This also means more stringent requirements to part clamping methods. All this is reflected in the design of machine tools manufactured at TCT.

The speaker then stated that by 1990 37 types of robotized workstations (RWS) for machine tools and 9 types of operatorless metalcutting machine tools (BMS) would be developed at TCT. Concurrently, work is conducted on developing devices for automated handling of machined parts, tools and chips. For handling nonrotating machined parts, rotary and mobile pallet feeders for machining centers have been developed. For handling of rotating parts, the following industrial robots were designed specifically for metalcutting machine tools:

an IPR-8 robot with a 2 x 8 kg load capacity, attached to a machine tool or installed on a longitudinal carriage next to the machine tool;

an RM-20 gantry robot with a 2 x 20 kg load capacity;

an IPKV-40 gantry robot with a 2 x 40 kg load capacity, which is a component of a BMS;

an IP-63 gantry robot with a 2 x 60 kg load capacity.

When developing BMS, each machine tool was intended for machining parts of certain types and sizes. Thus, for instance, SRU-32-BMS machine tools manufactured at ZPS [not further identified], Gotvaldov, are designed for machining rods up to 32 mm in diameter, shafts up to 50 mm in diameter and flanges up to 125 mm in diameter, and MTsFG-32-BMS machine tools (TOS, Olomouc) are designed for machining nonrotating parts on a 320 x 320 mm pallet.

The Institute developed methodological fundamentals for BMS. Of interest are requirements the newly developed equipment must meet.

Thus, for instance, a BMS for machining of nonrotating parts must have a central spindle, sliding plastic-coated guiding surfaces and large-capacity, preferably rack-type, magazines for holding 120 to 140 tools; they must be able to use various sizes of technological pallets in accordance with customer's needs; the pallets must be moved by means of a rail or induction guided carriage; and parts must be clamped by means of special clamps that reduce the number of workpiece reinstallations.

An MTsFG-80 machine tool exhibited at the 29th International Machine Building fair in Brno was the first BMS that took into account all the above requirements. The Institute is also developing principal components used in BMS, such as manipulators, control systems, measuring units and new types of tools and accessories.

Engineer Z. Glozhek, a representative of the Scientific Experimental Organization of Molding Technology (Brno), presented a paper **"Efficient Forming Technologies"**.

The speaker said that the Organization of Forming Technology is the leading organization in the CSSR in the field of pressure forming of metals. Along with technology research and development it also develops and manufactures machines for pressure forming, mechanization and automation devices and automated manufacturing complexes with manipulators and industrial robots. Forming centers and manufacturing complexes are delivered turnkey. Research that forms the basis for new equipment is given priority treatment.

Forming using a liquid under high pressure is an efficient method ofsheet metal processing. The Organization of Forming Technology developed and implemented a proces of hydromechanical deep drawing.Compared to the known process, this one makes it possible to make deeper and more complicated and accurate parts, such as, for instance, brake cylinders, sun shields, parabolic reflectors, dishwashers, stainless steel utensils etc. These parts are made on specially designed triple-action presses TsTM. This technology was also used for manufacturing of shaped pipe fittings. Prior to that, these parts had been made using forging, welding and machining, with attendant high labor and metal content and high power consumption. The new patented method makes it possible to manufacture shaped pipe fittings from steel drawn tubes, using a liquid under high pressure.

For this technology, a hydraulic press TsIT-630 was developed. It is used for making tees, crosses, spherical and other parts, 28 to 150 mm in diameter and with 2 to 8 mm wall thickness. According to calculations made by Czechoslovak specialists, implementation of this technology will save 78 percent of metal, 95 percent of labor and 85 percent of electric power.

The technology for forming shaped pipe fittings using a liquid is being improved in order to be able to make parts of stainless steel.

Under development is a technology for deep drawing of thick (up to 10 mm) hot rolled sheets of low-carbon structural steel.

According to professionals, as far as material, power and labor savings in manufacturing of small-size rotating parts are concerned, three-diemnsional cold stamping is one of the most efficient technologies. Compared to machining, labor content is 20 to 90 percent lower, and material content is 60 percent lower. For small series and for parts with complex shape, simple-action presses are most efficient, and for large-series production the most efficient are multiposition stamping automatic machines. In the CSSR, they make TPZK-25 automatic machines for manufacturing short (not more than 110 mm long) parts not more than 50 mm in diameter; TPZD-25 machines for manufacturing parts up to 250 mm long; and TDZR-6 and TDZR-8 machines for manufacturing M6 and M8 screws.

Among promising and economically efficient methods of three-dimensional cold stamping is forming in presses with a rocker die. This method is used in small-series production. Its advantage is that at each given moment the deformation force only acts upon a small portion of a part, thus making possible a larger deformation with a relatively small nominal press force, which only equals about 10 percent of press force in the case of the classic method of forming.

The Organization of Forming Technology pays serious attention to research in the area of cross rolling with wedges (CRWW), which is very efficient as far as reducing the metal content ofparts is concerned. CRWW is performed on roling mills model UL; using these mills, one can make rotational forging billets up to 110 mm in diameter and up to 750 mm long.

The Organization actively works on improving operating reliability of automated forging lines under adverse production conditions (vibrations, high temperatures, equipment contamination with lubricants and scale etc.) and on improving sanitary and hygienic conditions in production departments.

An associate of the State NII [scientific research institute] of Material Protection imeni G.V. Akimov (Prague) M. Svoboda presented a paper **"New Corrosion-Protection Technologies"**.

The speaker stressed that corrosion-generated losses can be reduced if one implements available research results in this field. Perfect corrosion protection of parts will facilitate their competitiveness. Increased manufacturer's cost due to application of corrosion protection can be offset by with savings in mechanization and automation of surface treatment processes. As an example, the speaker cited the fact that cost of manual aluminum metallization is four times higher than when an automated line is used. One can only increase labor productivity and service life of coatings and reduce cost while conforming to ecological requirements if one uses new progressive protection methods, first of all vacuum and plasma metallization. One should use robots and manipulators in automated paint coating lines and improve galvanic coating and enameling technology.

A well-known method for applying vacuum coatings is being improved in order to create the capability to apply wear-resistant coatings based on nitrides and titanium, tungsten, niobium and chrome carbides or oxides. Vacuum technologies are being developed at present because such coatings can only be applied by this method. Ecological safety of the process also plays an important role.

Enameling is widely used in various industries for metal protection. Enamel coatings are used in manufacturing of consumer goods and in the food, pharmaceutical and chemical industries. Lately, these coatings are being used for protecting power generation equipment, coating of large vessels used in agriculture etc. The speaker said that a new electrostatic method for application of enamel coatings had been developed, and a licence was sold abroad.

Aluminum spraying (metallization) technology is used in the CSSR for protection of steel structures and mine cars. A layer of aluminum, sometimes in combination with a paint coat (combined films) providescorrosion protection for the entire service life of a machine. The fact that service life of paint coatings in polluted industrial atmosphere is only 2 to 5 years attests to advantages of the new method.

Guns model AD-2 for manual metallization are produced seriesly.

A fully automatic metallization line was developed and has passed production testing. In the opinion of Czechoslovak specialists, the most efficient method for preparing a surface for coating is shotblasting with subsequent spraying of an aluminum layer. This process is becoming ever more widespread in the CSSR.

Plasma spraying technology is used for coating surfaces of large-size parts with refractory metal oxides and compounds, including ceramics and cermets. At present, fully automated lines for plasma spraying of coatings have been developed in the CSSR.

In order to give required properties to part surfaces, a new technology based on laser application and the principle of ion implantation into the surface of metals and alloys is being developed. It is planned that when using a laser, material applied to a surface in a powder (or any other) form will melt and as a result a layer that diffusively adheres to the surface will form. Using ion implantation, it would be possible to microalloy the surfaces.

The majority of surfaces in machine parts are corrosion-protected by sprayed-on organic coatings. As a rule, toxicity in paint departments at industrial enterprises is high. Labor safety requirements and emerging ecological problems call for replacement of toxic compounds with nontoxic, use of water-soluble paint coatings, wider application of powder paint coating materials and implementation of automated coating lines equipped with robots and manipulators.

According to the speaker, nontoxic corrosion-resistant pigments are already manufactured in the CSSR. A number of scientific research institutes and industrial enterprises are working on problems related toapplication of organic coatings.

Striving for improving the technical level of developments in various technological fields, Czechoslovak specialists place great importance on cooperation within the framework of the Integrated Program of S&T Progress of CEMA Member Countries up to the Year 2000.

12770

UDC 527.62

Estimation of Accuracy of Identification of Instrument Errors in Inertial Navigation Systems During Additional Rotation of Sensor Unit

18610204c Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30, No 10, Oct 87 (manuscript received 21 Apr 87) pp 62-67

[Article by A.V. Repnikov, V.A. Tikhonov, and A.V. Valdovskiy, Moscow Institute of Aviation imeni S. Ordzhonikidze]

[Abstract] Additional rotation of the sensor unit rather than intentional change of the target trajectory for determining the instrumental errors in an inertial navigation system considered. Starting from a system of two coupled variational equations for position error and velocity error, the components corresponding to instrumental error were identified. The additional rotation is selected so as to make the orientation matrix of the reference system of coordinates relative to the navigational one factorizable into a product of different constant-speed rotation matrices. A matrix differential equation in Ricatti form was solved, giving the diagonal elements of a matrix of covariance in estimation errors. This was used to show the dependence of instrumental errors on initial values of error dispersion, on the requirements placed on accuracy of identification, and the dependence of the estimation time interval on the instrument noise level. Figures 1; references: 3 Russian.

2415/12913

Trends in Improvement of Gyroscopes and Stabilized Platforms

18610204a Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30, No 10, Oct 87 pp 46-56

[Article by D.P. Lukyanov, L.A. Severov, Ye. L. Smirnov, and A.V. Til, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] Goals in current research concerning improvement of gyroscopes and stabilized platforms include constructing a perfectly spherical, and thus something other than a mechanical, suspension, whether gasdynamic, electrostatic, magnetic, or cryogenic; development of devices for tracking the orientation of the angular-momentum vector; and controlling the precession of the wheel or other gyroscope component. These goals apply to dynamically tunable as well as static gyroscopes. Concurrent trends in gyroscope theory and design are laser gyroscopes with the necessary cavity and fiber optics, with a better platform or without platform at all. Major aims are higher sensitivity to target perturbations and immunity to interference effects, miniaturization, and adaptability to digital automatic control. References 40: 35 Russian, 5 Western.

2415/12913

UDC 531.383

Synthesis of Parameters of Vibratory Rotor Gyroscope

18610200a Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30, No 9, Sep 87 (manuscript received 21 Feb 86) pp 76-77

[Article by I.G. Perminov, Perm Polytechnic Institute]

[Abstract] Vibratory rotor gyroscopes mounted on platforms because of constraints on elastic twist of inner gimbals are considered, motion of a stabilized platform being controlled by a torque transducer which tracks the position of the gyroscope rotor and on this basis sets the precession of the gyroscope. From the applicable equations of motion, taking into account torsional stiffness and internal friction but ignoring errors due to technological imprecision, relations are established between gyroscope parameters which will yield optimum performance. The article was presented by the Department of Aviation Instruments. Figures 11; references 1: Russian.

2415/12913

UDC 629.7.874

Analytical Estimates of Errors in Determination of Noncorrectible Gyro Orbit Orientation

18610200b Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30, No 9, Sep 87 (manuscript received 6 Aug 86) pp 78-80

[Article by A.N. Gerasimov and G.A. Svetashov, Leningrad]

[Abstract] A noncorrectible gyro orbit is considered and determination of its orientation in an orbital system of coordinates with the aid of an analog computer is analyzed for accuracy, the main errors of such a determination being gyroscope drift, methodological as well as instrument errors of local vertical indicator, drift of satellite orbit, and null drift of integrators. These errors are introduced into the equations for pitch and course angles as functions of time, assuming that the projection of the drift angular velocity onto the axis of these angles are equal to the same constant. Pitch angle was measured at not fewer than two points on the orbit and, from a statistical analysis of the data, coefficients of dispersion for pitch and course angles are tabulated as a function of the range of measurement of angle CP. Tables 1; references 1: Russian.

2415/12913

UDC 62-501.67

Spectral Approach to Synthesis of Adaptive Systems for Comprehensive Processing of Navigation Data

18610204b Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30, No 10, Oct 87 (manuscript received 8 Jun 87) pp 56-62

[Article by V.K. Ponomarev and A.I. Panferov, Leningrad Institute of Aviation Instrument Design]

[Abstract] Comprehensive processing of navigation signals in real time by means of a Kalman filter is considered, the classical approach based on the theory of linear filters being inadequate because of nonlinear transformations being required for matching instruments which operate on different bases and because of unavailability of accurate a priori information about instrument errors. Known adaptive algorithms involving use of heuristic weight factors or noncorrelation of residual terms are also inadequate, and even the most efficient algorithm involving identification and estimation of unknown parameters is impractical because the size of the expanded state vector makes it unwieldy for real time calculations. The spectral approach to construction of adaptive filtration algorithms, i.e. spectral analysis of discrepancy signals, is therefore proposed. A detailed derivation of an analytical form for spectral density Sgq is given; this formula is the basis for analysis of the discrepancy signal spectrum, which in turn determines what filter parameters should be. A simple first-order system is given as an illustrative example, and an adaptive filter is synthesized on this basis. The article was presented by the Department of Aircraft Orientation and Stabilization Systems. Figures 3; references: 5 Russian.

2415/12913

KsVA 700-180 and KsVA 650-135 Condensate Pumps

18610178a Moscow ENERGOMASHINOSTROYENIYE in Russian No 2, Mar-Apr 87 pp 28-29

[Article by Engineers G.V. Vizenkov, A.S. Kosyanenko and V.V. Moskalenko]

[Abstract] Condensate pumps, used in AES [nuclear power plants] with VVER-1000 reactors and K-1000-60/3000 and K-1000-60/1500 turbines for pumping separate out of separators-superheaters and pumping condensate out of low-pressure heaters into the main condensate line are described. Because of the high values of the pumped liquid temperature and pump inlet pressure, the design of certain pump components, such as the upper and the lower bearing, the free shaft end seal, the seal between the intake and the pressure chamber and mounting of the unit on the foundation, is different than that in series-produced pumps. The pump rotor is relieved from axial forces by means of a balance piston. The free shaft end is sealed with a T-85 end seal. Normal operating temperatures are maintained by an independent loop with an external heat exchanger. The seal between the intake and the pressure chamber is a metal gasket, made of corrosion-resistant steel and compressed by the pressure differential between the pressure and the intake chambers. Axial and radial clearances in the foundation mountings provide free linear expansion of the pump in the pumped liquid temperature range from 20 to 200 °C. Experience gained with the above pumps will make it possible to use them as the basis for developing new pumps for K-800-130 turbines for AES with BN-800 reactors and TK-450/500-60 turbines for nuclear thermal power plants with VVER-1000 reactors. Figures: 4.

12770

Prospects for the Developement and Improvement of Compressor Machines

18610178d Moscow ENERGOMASHINOSTROYENIYE in Russian No 2, Mar-Apr 87 pp 39-41

[Article by Engineers V.V. Arkhipov and V.M. Kamenev and Candidate of Technical Sciences A.V. Stolyarov]

[Abstract] New centrifugal and axial compressor machines developed and manufactured by the Nevskiy Zavod PO are described. Gas blowers of the 235 and 650 series are used in gas pumping plants for main gas pipelines. Several modifications of the basic design are available. Insofar as their technical and economic indices are concerned, they are among the best in the world, and as far as their mass and overall size, they are in some cases without equal. During the 12th Five-Year Plan, gas blowers for gas turbines will be developed, with similar developement for steam turbines planned for the future. Electrically driven gas pumping plants designed for unattended operation are being planned. A machine for pumping gas with a wide range of density fluctuation is being designed. Nevskiy Zavod PO will also develop compressor machines for blast furnaces which will be driven by a steam extraction turbine and/or by an electric motor. They will cover a wide range of productivity changes with constant end pressure and have a high economic efficiency. Advantages of the new machines are described. Figures 1, references: 2 Russian.

12770

300 MW Cryogenic Turbogenerator Being Developed

18610027 Moscow SOVETSKAYA ROSSIYA in Russian 11 Oct 87 p 1

[Article for SOVETSKAYA ROSSIYA by TASS correspondent S. Davydov: "Algorithm for Creativity. World's First 300,000 KW Cryogenic Turbogenerator Being Developed"]

[Text] The outlines of the electric machine of the future are visible on the test benches of the Elektrosila association. Assembly work on the world's first 300,000 kW cryogenic turbogenerator is being completed here. The superconductivity of metals at temperatures close to absolute zero used in its design opens tremendous possibilities for electrical engineering. The unusual design makes it possible to design superpowerful turbogenerators which will be from 2 to 2.5 times lighter than the traditional ones, thus making them more efficient.

Work on the machine is still continuing, and it will be a long time before it will operate at one of Leningrad's power stations. However, today we can already speak about the great success of domestic science and technology. Soviet specialists in their work on the high power cryogenic generator are well ahead of specialists from the developed capitalist countries. They have established the necessary theoretical and practical basis for development of such high-power machines.

The manager of Elektrosila's design division, Doctor of Technical Sciences I. Filippov shares his thoughts with me: "Being well ahead of the closest competitors, strange as it may sound, creates additional difficulties in realizing the project. The old "wait-and-see psychology" develops: in many cases we have to listen to responses from organizations that we're trying to get to fund us, saying that maybe we shouldn't be in a hurry, and that the Americans have abandoned their projects".

For many years now, this highly qualified designer has been spending most of his working and personal time clearly not on his profession: he has been "beating the bushes" for money, metal, and parts all over the country. In one city he makes a deal to manufacture a superforging of titanium and in another city he arranges to have it machined. All orders are above-plan and the Leningraders may be refused. However, such occasions are rare.

"People in our country are conscientious", the specialist says. "However, sometimes anger takes over: why is the whole economic mechanism so 'unconscientious'?"

There is, of course, some exaggeration. With all the deficiencies in our economy, which have been discussed so many times during recent years, the process of developing a fundamentally new machine was organized enviably well at Elektrosila. Early on, before even the design of the machine had started, the cryogenic basis for production of liquid helium at -269 deg C was developed. A unique "plant" was built. This plant will supply the necessary refrigeration for both the test machines and the series-produced cryogenic "millioniks" [GW-power generators] which will definitely go into production in the next few years. Also, scientific and technical ties with the Czechoslovak combine Skoda to develop the cryogenic technology were established beforehand. The list of similar measures is very long. The achievements in developing the new generation machines to a considerable extent were predetermined by the far-sighted technical policy of the collective, which found support from both local and central authorities.

Earlier than others, Elektrosila's collective started to use computers in production and design. Now, engineers "play with" design variants on their monitors. Now, the Leningraders are surprising many people with their project for teaching a computer to do creative design. The decision was made to enter the knowledge, experience, and even thought processes or algorithms of the enterprise's leading specialists into computer memory. It takes a long time, and it probably is too early to explain how they do it, but there has already been some success with this unexpected use of the "human factor".

It seems that the Leningrad electric machine builders never paid tribute to the notorious "wait-and-see psychology". The history of the collective is marked by glorious victories for labor. From the first days of its birth, Elektrosila challenged the leading western firms by deciding to build its own generators for the "first-born" of the GOELRO plan [State Plan for the Electrification of Russia], the Volkhov GES. These Leningrad machines are in operation at Volkhov still today, thus proving the high qualifications of the Soviet workers and specialists. Dneproges, Volga, and Angara followed. Almost half of the country's power stations are equipped with Elektrosila machines. However, years of stagnation left their toll on the collective: standards were lowered and a conciliatory attitude toward deficiencies was growing. There is just one proof: in 1985 not a single outdated piece of equipment was discontinued. During last year and this year, almost 50 types of equipment were discontinued.

The drive to carry out perestroyka without awaiting instructions and orders is, probably, the raison d'etre for the collective, which is realizing the decisions of the 27th Party Congress.

For many years, the "stumbling block" in designing new equipment was in meeting standards. Much has been written and said about the petty regimentation imposed on designers and the long time necessary for coordinating the projects with various authorities. Elektrosila together with collectives of a number of Leningrad enterprises and Uralmash are engaged in a real struggle with this situation. As a result, many seemingly immutable standards specifying production of new equipment were revised.

Partkom Secretary A. Yegorov said: "We added new tasks to Leningrad's Intensification-90 program that concerned the association directly. The collective decided to increase the rate of removing old equipment from the shops by switching the to 2- and 3-shift operation of the newer machine tools. Thus, we got rid of more than 300 outdated machines and increased the operating time of the remaining equipment by 2 hours on average. However, that was the end of it. Machine tool builders have cancelled a series of contracts with us. For the time being, they are unable to supply new equipment at the specified rate. It's a case where the enterprise has a right to use its own hard currency reserves for reconstruction of production and the enterprise has these funds (Elektrosila supplies its products to 85 countries), but at the present time the association cannot buy the machine tools."

However, the enterprise did manage to use the right to directly enter foreign markets in spite of foreign trade organizations who bear a grudge because of it. During the "Made in Poland" exhibition in Leningrad, a contract with the firm "Elwro" from Wroclaw on supply of electronics was signed. The electronic components will be paid for with funds received by the association from sales of its products in Poland.

A foreign trade unit created at the enterprise is searching for ways to increase exports. The specialists in different fields who form the unit study markets, discuss proposals concerning supplies and outlook for producing new and more competitive equipment, and plan consortiums with the participation of foreign firms for resolving especially difficult problems.

13355

MHD-Scientist Velikhov Receives Faraday Medal

18610009 Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 3 Oct 87 p 3

[Article by TASS correspondent R. Akhmetov: "A Sign Of Recognition for Scientific Merit"]

[Text] The vice-president of the USSR Academy of Sciences, academician Ye.P. Velikhov has been awarded the prestigious Faraday Medal. He received it on 2 October at the 11th International scientific forum on power engineering, which is taking place in Moscow.

In this way the world's scientific community noted the outstanding contributions of the well-known Soviet physicist to development of basic and applied research into magnetohydrodynamics (MHD), which is one of the most promising methods for direct conversion of heat into electrical energy.

The Soviet Union is foremost in the development of this field of power engineering. In 1964, the first pilot installation based on MHD energy conversion principles generated current at the High Temperatures Institute of the USSR Academy of Sciences. Successful operation of such installations allowed scientists to resolve the most important scientific and engineering problems in generating electric energy using the interaction between ionized combustion products heated to tremendously high temperatures and a magnetic field.

Presently at the Ryazan GRES a 500 MW commercial power unit is being constructed. It consists of a 270 MW MHD-generator and a regular steam turbine. What does this novelty promise? At the best steam power plants only 40 percent of the coal, oil, or gas being burned goes toward obtaining electrical energy. But the MHD-generator will increase the efficiency to 50-60 percent.

The magnetohydrodynamic effect is presently used also for "seeing through" into the deep interior of the Earth. Under the leadership of Ye.P. Velikhov, a series of MHD-generators have been developed and are being used in geological and geophysical practice for electromagnetic scanning of the Earth's core.

13355

Response to Ryazan's MHD-Plant Engineering Shortcomings

18610074 Moscow STROITELNAYA GAZETA in Russian 16 Dec 87 p 3

[Article by Doctor of Technical Sciences A. Gubarev: "You Must Reap. . ."]

[Text] **Responses to the article "Hypnosis of Golden Promises" (STROITELNAYA GAZETA 31 Oct 87), which was written to prove that the construction of the large Ryazan MHD-plant [magnetohydrodynamic plant] was started without sufficient engineering-technical and economic justification, continue to come to the editing board. Part of these responses were published in this newspaper on 27 Nov 87.**

Today, a scientist in power engineering A. Gubarev shares his thoughts on the subject. In addition, we are publishing the first official response from the USSR Minenergo [Ministry of Power and Electrification]. After we receive responses from the USSR Academy of Sciences and the GKNT [State Committee for Science and Technology], our readers will have the opportunity to get familiar with them too.

The article "Hypnosis of Golden Promises" absolutely and correctly reflects the situation which is formed today in the practical realization of the magnetohydrodynamic method of energy conversion. Due to the nature of my studies and scientific interests, I am quite familiar with this problem, and, therefore, the facts described in the article were not unexpected to me. However, the clear and justifiably sharp statement of the problem and the bold challenge of the stereotype formed in leading circle of the scientific community that the Institute of High Temperature at the USSR Academy of Sciences,[IVTAN], had achieved outstanding results in developing the MHD-method, drew my special attention. To my knowledge, the opposite is true.

It is known that during the last few decades the rate of improving the efficiency of steam power generating plants was rapidly coming down. This is connected with exhausting the possibilities of steam power units which have a maximum achievable efficiency of around 40 percent.

Therefore there was a natural interest toward the MHD-method of energy conversion which provides an outlook for achieving an efficiency of around 60 percent. And the Government did no spare funds for development of this method. For the last 25 years, a series of unique experimental units were developed at the IVTAN including the world's largest U-25 facility operating on natural gas with thermal power of up to 355 MW (that is, approximately one-third of the thermal power of the MHD power unit being built at the Ryazan MHD-plant). One may state that the actual expenses of developing this technology in the USSR are close, if not larger, than total expenses of all foreign firms together.

Already at the early stage of research, scientists identified the main problems needing to be resolved before the MHD-method of electric power generation could become competitive in the field of stationary power generators. I do not want to bother the readers with technicalities, but in this particular case we cannot ignore them. Thus, the following had to be developed: a unique superconducting magnetic system with a volume of over 100 cubic meters; MHD-generator's channel walls capable of long time operation at temperatures of around 2000 K in aggressive medium and high intensity electric fields; methods of removing salts of alkaline metals and nitrogen oxides from combustion products, etc.

These extremely difficult tasks requiring tremendous purposeful efforts are not resolved as yet. Even more, the results of a series of concrete problem studies achieved by the IVTAN designers are substantially more modest than those achieved abroad.

It is understandable that with such a scientific background we should not start the industrial implementation of this method. However the management of the

Institute, which had totally monopolized all work connected with the MHD-conversion, was persistent in their efforts to start construction of a large electric power plant. And how did the designers intend to bypass the numerous difficulties lying ahead? They used for these purposes so-called "bypass solutions", that is, technical palliatives that brought sharp (beyond limits of reason for building the power plant) increases in the cost of generated electric power and reduction in the MHD power plant efficiency.

For example, it is more expedient to increase the temperature of combustion products at the MHD-generator by using the heat of exhaust gases. However, these gasses have an alkaline impurity which makes the task very difficult. The designers proposed to use natural gas burners in the air heaters. Naturally, this reduced the efficiency of the unit. Therefore, in order to "pull out" this factor by any means, they took a path of a significant increase in the superconducting magnetic system cost.

In another case, instead of extracting nitrogen oxides, they decided to break them up. It is simpler to do, but they had to increase by several times compared with the original the size and metal weight of the MHD-generator and steam generator exhaust parts. Failure to use cardinal solutions of complex problems caused such an increase of the MHD-plant cost and decrease in efficiency, that the plant became less efficient than the existing power units. And the most important fact is that the technical solutions used do not open any outlook for developing the MHD power engineering.

Some specialists were saying this all for quite a long time. Nevertheless, the construction of the Ryazan MHD-power plant began.

A fundamental question arises: How could it all happen? I think that the boundary conditions of those years played an important role here. Reasonable solutions contradicted the expense mechanism of scientific development; promises were valued substantially higher than concrete deeds; and priority was given to the immediate construction of huge projects based on "scientific IOU's" rather than for detailed studies.

Exactly these conditions provided the possibility for a comfortable existence of scientific collectives regardless of their input into scientific-technological progress. And what is more, the scientific authority of a collective was directly proportional to the amount of funds being assigned to the project.

Construction of giant facilities without the necessary scientific-technological justification not only costs society dearly, but it diverts resources and restrains development of alternative solutions. Thus, already in the mid-50's the Academician S.A. Khristianovich proposed the steam-gas cycle. Much water has flowed under the bridge since that time, and numerous arrangements of the steam-gas cycle were not practically receiving any support. One of the reasons for that was the fact that the gas turbine cannot work on cheap coal and sulfurous residual oil. As to the MHD-generator, it can use these fuels, and therefore, it is deemed to be better to invest funds in its development. However, today it has become clear that the unit developed at the IVTAN specifically must use natural gas. Meanwhile, abroad the steam-gas facilities with efficiencies reaching 47 percent are already being developed, which realistically assures a substantial increase in efficiency of the steam electric power plants.

I would not like to create the impression that I challenge the competency of the IVTAN collective. I have longstanding scientific contacts with a number of the Institute's specialists, whom I highly respect and value. They carried out a large number of interesting and original works including those concerning the development of the MHD-power unit. However, this cannot change the general situation, when owing to somebody's folly, the society must pay hundreds of millions of ruble and experience a slowdown in the scientific-technological progress as a result of a rejection of alternate projects.

The lessons of the Ryazan MHD electric power plant, as I see it, have a generic character. It would be worth while to analyze them with a complete openness and to reveal the mechanism which leads to creation of such problems. In other words, we must call things by their real names which is what the traditions of glasnost require. Because often this is more important than any, even the most correct, but "closed" administrative decisions.

13355

USSR Minenergo Response

18610074 Moscow STROITELNAYA GAZETA in Russian 16 Dec 87 p 3

[Response by the deputy Minister of the USSR Ministry of Power and Electrification, A. Dyakov]

[Text] The USSR Minenergo discussed the article "Hypnosis of Golden Promises. Ryazan MHD Electric Power Plant: Reality or Myth?" published in STROITELNAYA GAZETA of 31 Oct 87 and considers it to be correct in reflecting the situation with the MHD power plant design and construction.

At the present time, construction of the steam turbine part of the MHD power unit is being completed. As to construction work on the MHD-generator and its auxiliary systems, the work for all practical purposes has not been started yet.

The Ministry is in agreement with the newspaper that construction of a facility of such a scale and purpose was started without the critical assessment of the experimental data and the potential technical-economic parameters of the method.

The comparison of the main technical-economic parameters of the MHD-conversion with the modern steam-gas facilities and steam turbine units operating on natural gas shows that it does not have significant advantages but does have significantly more complex equipment. An MHD-generator on solid fuel may be of certain interest.

In July 1987 the Institute of High Temperatures at the USSR Academy of Sciences proposed changing the design of the magnet for the MHD-generator, which makes it substantially different from the solution described in the technical specification. Therefore, redesign and reapproval of the technical specification of the MHD part of the power unit are necessary. This specification will be widely discussed, examined by experts, and submitted to the USSR Council of Ministers.

13355

Chernigov Conference on Productivity of Non-Anticlinal Traps

18610112 Kiev VISNYK AKADEMII NAUK UKRAYINSKOYI RSR in Ukrainian No 11, Nov 87 pp 87-88

[Article by Corresponding Member, AN USSR [UkSSR Academy of Sciences] V.K. Gavrish and Candidates of Geological Mineralogical Sciences V.G. Demyanchuk, Yu.A. Arsiriy and A.I. Nedoshovenko]

[Text] On the initiative of section "Tectosphere of the Dnieper-Donets Depression and Donbass Trough" of the Scientific Council, AN USSR, on the problem "Ukraine Tectosphere", a scientific technical Conference took place in Chernigov in April of 1987. The Conference was devoted to problems of accelerating the discovery of new types of traps and oil and gas resources in the Dnieper-Donets Trough (DDT). It was organized by the Ukrainian Republican Board of the Scientific and Technical Society of Petroleum and Gas Industry imeni Academician I.M. Gubkin (STS PGI), UkSSR Academy of Sciences, UkSSR Ministry of Geology, production association "Ukrneft", All-Union production association "Ukrgazprom" and Chernigov oblast Board of the STS PGI. Professionals in the field of oil and gas geology involved in exploration, prospecting and industrial production of oil and gas in the DDT, as well as representatives from AN USSR, the All-Union Scientific Research Petroleum and Gas Institute (VHIGNI), Ukrainian Scientific Research Geological Prospecting Institute (UkrNIGRI), Ukrainian Scientific Research and Design Institute of Petroleum Industry (UkrgiproNIIneft) and Ukrainian Scientific Research Institute of Natural Gases (UkrNIIgaz) participated in the Conference.

Acting Chief of the Petroleum and Gas Exploration and Prospecting Administration, Mingeo USSR [UkSSR Ministry of Geology], V.G. Demyanchuk opened the Conference. Presentations on behalf of authors' collectives were made by I.I. Bartkiv (Mingeo USSR), M.I. Marukhnyak (UkrgiproNIIneft), A.M. Istomin (UkrNIIgaz), V.Ya. Zolotarenko (production geological association (PGO) "Ukrgeofizika"), L.I. Ryabchun (Geological Sciences Institute (IGN), AN USSR), B.D. Goncharenko (VNIGNI), Yu.A. Arsiriy, A.I. Kovalchuk, A.Yu. Lukin, N.Ya. Baranovskaya, B.P. Kabyshev and V.M. Lakhnyuk (UkrNIGRI), M.I. Blank and M.I. Machuzhak (PGO "Poltavaneftegazgeologiya"), and L.V. Kurilyuk and T.K. Galchenko (PGO "Chernigovneftegazgeologiya").

Yu.L. Sokolova (Central Thematic Expedition, UkSSR Ministry of Geology), V.I. Sozanskiy, A.I. Nedoshovenko and Yu.A. Muraveynik (IGN, AN USSR), T.I. Shumilina (UkrNIIgaz), Z.Ya. Voynitskiy (PGO "Ukrgeofizika") and I.V. Vysochanskiy (PGO "Poltavaneftegazgeologiya") reported results of their studies.

P.F. Shpak and A.I. Nedoshovenko (IGN, AN USSR), V.I. Savchenko and I.S. Roslyy (UkrNIGRI), A.M. Istomin (UkrNIIgaz), M.I. Galabuda (Geology and Geochemistry of Combustible Minerals Institute (IGGGI), AN USSR) etc. took part in the ensuing discussion.

Conference participants came to a conclusion that at the current stage of exploitation of DDT mineral resources reserves of anticlinal seams that can be sufficiently well detected with the help of traditional seismic prospecting methods had been practically exhausted and that continuing the work in this direction would only result in lower efficiency and a substantially lower volume of work.

Previous years' practice had confirmed the presence of industrial accumulations of hydrocarbons in non-anticlinal traps. However, in order to successfully segregate and prepare them for deep drilling and to conduct exploration and prospecting, one should radically change the methodology of geological and geophysical research, beginning with regional work; nonformally integrate research at all stages; substantially broaden the capabilities of seismic prospecting, especially in geological section forecasting; and reevaluate and revise research methods (remote, geochemical etc.) that have not been widely used in oil and gas exploration and prospecting.

The need for deep and comprehensive studies of the substance composition of promising deposits and regularities in changes thereof along a lateralis and a section, creation of unified regional correlation of productive horizons and detailed studies of their structure, with subsequent use of all derived data in geological interpretation of geophysical information, are distinctive features of the current stage in geological prospecting. The effect of all types of forecasts of oil and gas content on the end results and the efficiency of evaluation of productivity of local non-anticlinal objects increases, and this in turn calls for constant improvement of forecast quality and degree of detail.

Conference participants stressed the need for comprehensive studies of regularities in distribution of hydrocarbon deposits at large depths under rigorous thermobaric conditions, including conditions in Devonian deposits. At these depths, industrial oil and gas content of sedimentary formations mainly depends on geotectonic development. Oil and gas traps at large depths should be forecast with consideration given to factors that impede or facilitate section defluidization (in fast-accumulating strata and in zones of abnormally high srtatum pressure, or quite the reverse, in strongly metamorphized terrigenous strata).

Facial-geotectonic research demonstrates that longitudinal and lateral tectonic elements and deep fractures bordering on them are reflected in the lithofacial composition and in the thickness of lower coal and Devonian deposits, including individual rhythms of sediment accumulation and productive horizons. Due to changes in geotectonic conditions of sediment accumulation, favorable conditions for lithologic restrictions, for stratigraphic and tectonic shielding of both whole rhythms and individual collecting horizons, and for accumulation of mound, bed, bar etc. sandstone can form in certain territories (in zones where rift and prerift fractures join, in fracture areas bordering on foundation shelves and in paleocanyons).

Conference participants noted serious prospects of the boundary Devonian-Carbonian fracture range and of transient ranges in the Lower Carbon, where a number of independent oil and gas complexes were identified (Rudenkovskiy and Limanskiy strata, the polyfacial thickness of the 12th microfaunistic horizon etc). One should conductcomprehensive scientific processing of factual materials, in order to determine lithologo-facial types of rocks that form and governstratigraphic and genetic characteristics of oil and gas containers and cap rocks.

In addition to granular containers, carbonate formations in the region are also promising, as far as oil and gas are concerned. The lack of comprehensive and systematic generalizations in the area of lithofacial and paleogeographic analysis of conditions for the development of lithologostratigraphic, lithologic and combined traps is one of the reasons for the low rate of success in exploration of non-anticlinal deposits.

In order to forecast, identify and prepare new exploration objects using seismic prospecting, a technical and methodological foundation is required. It must be based on new technology, detailed and in-depth computer processing of seismic information and new approaches to theinterpretation of geological and geophysical materials, including results of seismostratigraphic, paleostructural and parametric (based on kinematic and dynamic characteristics of seismic waves) analyses.

Considerable experience in forecasting DDT thin-layer objects in theinterwell space has been accumulated. It is unfortunate, however, that no paper on seismostratigraphic analysis was presented at the Conference.

Speeches critisized scientific research institutes and production organizations. It was stressed that geological and geophysical organizations do not have time-tested methodological support for mapping and evaluation of productivity of non-anticlinal traps, neither they have a backlog of work for practical implementation of this new trend. One has to make up for this lag while conducting exploration and prospecting.

Attention was focused on the need to develop procedures and techniques for determiing the type of non-anticlinal hydrocarbon traps, combined with each other and with weakly pronounced structures (low-amplitude, deformed bulges etc.), which can be disocvered not only by seismic prospecting, but also with the help of aerospace and other methods.

The Conference adopted a resolution with specific recommendations on improving geological and geophysical research methods, organization of work and evaluation of new types of traps. It came to a conclusion on the high priority of prospecting for non-anticlinal traps and hence on the need to conduct all work and studies in great detail, down to a stratum or productive horizon level.

12770

Ryazan's MHD-Power Plant Status Discussed

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[Article by V. Veselov and O. Tatevosyan, Novomichurinsk-Ryazan-Moscow, special correspondents for the paper: "Hypnosis By Golden Promises: Ryazan's MHD Power Plant, Reality or Myth"]

[Text] The Ryazanskaya GRES [State Regional Electric Power Station] is impressive in its dimensions. And its giant power units look like thin teenagers alongside a hundred-meter bulky and cumbersome object. It is clear even to those who are uninitiated: something grandiose and unusual is being constructed. And that is how it is. Here in Novomichurinsk they are constructing the first magnetohydrodynamic electric power station in the world—the Ryazanskaya MGDES.

According to the plan it should go into operation in 1989. But it will not. And not in 1989 or in 1990. Just like in 1985, although the leaders of the USSR Minergo [Ministry of Power Engineering and Electrification] and the scientist-developers already at the beginning of the last 5-year plan designated such a period. Moreover none

of the builders will have the courage to state in general when the station will start up, a station which does not have, as it is accepted to express, any analogs in world practice. Why?

We began the searches for an answer to this question with a visit to the USSR Promstroybank. There we received the following information: the overall estimated cost of the project is 407 million rubles. The administration in charge of building the MGDES is not managing with the 5-year plan. Around 80 million rubles have been assimilated. Taking the lag in 1988 into consideration, as an example, it is necessary to acquire more than 142 million. The builders have not come close to such a figure.

In Novomichurinsk G. Kutylovskiy, head of the administration in charge of construction, presented us with a list of petitions for the causes of the springing up of routine long periods of construction: no people, the suppliers let us down, the supplies were quite useless, etc.

"But Gennadiy Ivanovich, this is an unusual project, so to speak, a complete revolution in power engineering. And at the work site not only is there no evidence of labor enthusiasm, there is simply no anxiety about the state of affairs."

And here Gennadiy Ivanovich simply stunned us:

"Correct, there is no enthusiasm. And how can there be, if up until now we still do not know what we are building? The station consists of two units: the MHD-generator, where the direct conversion of thermal energy into electrical takes place, and the traditional steam generator, operating on the heat of exhaust gases.

"Everything about the steam-turbine section here is understandable," the builder continues, "therefore we fall in battle, we get it done in the established period. But the main thing is not the boiler, but the MHD-generator, the heart of the station. There is no working documentation at all for it, and it is not clear when there will be. The only documentation there is for the building. We will assemble it, and then what? This means to work in the blind, if nothing is known about the 'filling.' What equipment is there, how much does it weigh, how is it to be arranged, everything has to be taken into account. There is talk about thousands of tons."

It must be admitted that it was difficult to believe this. To construct an MGDES without having solved the problem of the generator, this is the same thing as constructing a hydroelectric power station without knowing if water can get to its turbines. However, such an analogy is precisely appropriate. For example, at the station they have completed the work in the shop for the assembly and repair of the magnet. It is a huge building with a height of 30 meters and an over-all area of more than 26,000 square meters. But up until now there is not even a plan of the unique equipment which should be located in its main bay. Therefore it remains unclear, was it necessary in a literal sense for the builders to storm the recond height, or to be able to limit themselves to more modest dimensions, thus saving several million rubles at the same time.

Nevertheless, having talked with the contractor, you have to hear out the customer. V. Volkov, director of the MGDES which is under construction, precisely and with knowledge of what was going on expounded the claims to the contracting organization: you did not lead, you did not support, you did not prepare. And with regards to the working documentation? The director thought for awhile and then named the figure of support—70 percent. And the situation with the MHD-generator is most complex of all.

How much more complex was explained by the information from the Promstroybank: today there is neither a working plan nor the technical specifications (technical assignment) for a generator—that part of the station for which everything is being done. All the main elements are absent—the MHD-channel, systems for supporting it, emergency protection, diagnostic devices, and a superconducting magnet system. The same unexpected situation was embraced in the dry reference to the inquiry, "In accordance with the decision of the principal designer for the creation of the MHD-generator, dated 29 July 1987, the development of a superconducting magnet system of the dipole type has been suspended."

What happened? And what about the planned periods of putting the station into operation which had been approved?

Such questions were also put to the principal designer of the MHD-generator unit, director of the Institute of High Temperatures, AS USSR and Hero of Socialist Labor, academy member A.Ye. Sheyndlin.

"We have come up with a new, much more promising idea for the construction of the magnet system," said Aleksandr Yefimovich. "True, its realization will put off the start-up of the MGDES to 1992 or 1993, but then in essence the main industrial unit will be created for working out all the parameters of the most promising direction in the development of power engineering."

And what does the chief engineer of the Ryazanskaya MGDES project, A. Bryskin from the Moscow department of the Teploelektroproyekt institute, think about this reason?

"Today there is no clearness on the status of developments concerning an MHD-generator. Planning of the MHD-power unit is not going on due to the absence of the basic initial materials, which should have been recommended by the developer-IVTAN [Institute of High Temperatures, Societ Academy of Sciences]."

"And its new idea?"

"Yes, we know that at the institute they made the decision to discontinue the development of a magnet of the design which was contained in the approved technical plan, and to move on to the development of a new design. But the technology and period for producing the new magnet, its cost, weight and overall dimensions are completely unclear. And there are no guarantees that the design of the new magnet will turn out to be well-grounded, or will history repeat itself. In general I know nothing."

An old Russian proverb goes: words are silver, promises are gold, but the future is the will of god. Taking into consideration that in this case not only the words and promises, but also the measures being carried out on their basis actually have the weight of gold, it is evident that a guarantee is required which is more solid than an unpredictable heavenly providence. As is known, such a guarantee is given by scientific investigations, experimental check and operating experience. What are they talking about?

Before answering this question, let us recall what is known from schoolday physics. In a conductor which is intersecting a magnetic field an electric current develops. Back in 1832 the great Faraday predicted that both a liquid and a gas could be such a conductor. But it was not his fate to prove in practice the correctness of his own theory. This was done by his followers, but 20 years later. Then more than half a century later the first patents for an MHD-generator were issued. The same amount of time was required for the creation of the first test installations, based on the principle of direct conversion of thermal energy into electric energy.

Why do MHD-generators interest power-engineering scientists? At thermal electric power stations, which provide around 80 percent of the electric power generated in our country, in the best case only 40 grams of fuel from each 100 goes to the consumer in the form of electricity. The remaining 60 literally escape into the tube. And this is hundreds of millions of tons. It is understandable that each percent of useful consumption of unused resources is a major economic achievement. And 20 or 25 percent is in essence a revolution in power engineering. And the developers of the MGDES promise to achieve a similar result. True, nobody in the world has been able to do this yet, and work is being carried out on modest scales. The need for very large expenditures with an unclear practical result frightens people off.

We have acquired the greatest scope in this affair. The Institute of High Temperatures has been conducting investigations in the area of MHD-power engineering for more than 20 years. According to the testimony of S. Pishchikov, deputy director of the institute, up to 300 million rubles have been spent on these ideas (without the expenditures for the Ryazanskaya MGDES). The U-25 industrial pilot installation with a rated capacity of 25,000 kilowatts was constructed and had been in operation for more than 10 years. It has been in for major overhaul for the last 5 years. Many times the managers at IVTAN have come forward in the press and on television with stories about the "most economical energy," and about the engulfing promise of the era of MHD-power engineering. There have also been notices on this theme in "Stroitelnaya Gazeta."

The results of the operation of the U-25 were presented in corroboration. Already in the spring of this year at a session of the presidium of the USSR Academy of Sciences A. Sheyndlin noted that the undertaking of setting up major experimental installations has been resolved only by us in this country and in this we are ahead of other countries by 7-8 years. Having such a remarkable experimental base, the developers have conducted numerous experiments and have accumulated a great deal of experience. This made it possible back in 1977 to go ahead on the development of plans for a commercial MHD-electric power station.

Thus the plan for the Ryazanskaya MGDES with a power of 580,000 kilowatts emerged. In 1984 the expert commission of the GKNT [State Committee on Science and Technology, Soviet Council of Ministers] reviewed it. The conclusion: "Recommend approval." However, the following was noted at that time: "The MHD-power unit under consideration, which according to calculations will produce a savings of 11 percent of fuel, is inferior to modern steam-turbine power units as regards a number of indices (specific capital expenditures, number of personnel, outlay of electric power for internal needs, duration of continuous operation with the MHD-channel)."

How do you interpret this?

The specific capital investments for construction of the MGDES according to the plan comprise 530 rubles per 1 kW as opposed to 150-160 rubles for a GRES with steam-turbine equipment, the expenditure of electric power for internal needs—16.8 and 2.5 percent respectively, number of hours of utilization of rated power a year—5,250 and 6,800. Therefore, according to the technical plan the cost of a kilowatt-hour was determined as 1.8 kopecks. The experts at the Goskomtsen did not agree with such an evaluation and as a result of their calculations accepted another figure—2.1 kopecks. This more than doubled the average index in thermal power engineering.

However, today the director of the MGDES which is under construction names another figure for the expected cost: 3.2 kopecks per kilowatt. This is according to the refined calculations of the Minenergo itself. What will the future be? How did the expertise of the GKNT "avoid" this economic nonsense of the new equipment? Very simply. It was proposed that the Ryazanskaya MGDES be included in the ranks of a commercial pilot

plant operation for the purpose of "working out technical solutions for the development of more economical and reliable series-produced units with MHD-generators." And then in bright colors a description was given of what advantages the future series-produced MGDES would promise to the national economy.

True, the expert commission still added a fly to the ointment, which with respect to those sad times could be assessed almost as a civic feat. The plan called for the shutting down and repair of the MHD-generator after every 250 hours of operation (according to the IVTAN report such was the operating life of the U-25 commercial pilot installation). It was assumed that 2 days would be spent for repair. Thus the MHD-power unit had a "running time between servicing" which was completely unacceptable for power engineering. Therefore, in its conclusion the commission proposed to the USSR Minenergo and IVTAN that during the subsequent stages of planning and construction measures be taken for increasing the duration of continuous operation of the MHD-generator without repair up to 2,000 hours. It is not excluded that it was namely this requirement which turned out to be an important, if not the decisive factor of the present-day absence of "clearness with respect to the status of development of the MHD-generator."

Nobody took upon themselves the task of thinking, was it worth relieving the state treasury of half a billion rubles for the sake of developing an object which "requires further working out and improvement." Maybe for this purpose a less grandiose, and correspondingly a less expensive installation would have been suitable.

But there has been an installation in existence for a long time. As was already stated, the results of the operation for the U-25 were the basis for the plan for the commercial MHD-power unit. And suddenly again we have a commercial pilot installation with the same problems.

Neither the GKNT nor the USSR Academy of Sciences, nor the Minenergo posed such questions to the scientific head and the main developer of the MHD-generator—IVTAN. As if the entire process of making a decision took place under hypnosis, and in that stage which in medicine is called a paradoxical phase of inhibition and is characterized by a particularly high degree of suggestibility, when weak stimuli (a word, for example) act more effectively than strong (for example, anguish). In this case—anguish for the national good.

And now the time has come to pay the prominent bills. True, it might not have come if time itself had not changed. Today it requires deeds, and not lulling words. The disruption in the developments of the MHD-generator prior to its planned start-up earlier most likely did not cause any negative emotions. They would say the same thing that was said to one of the authors of this article by the head of the MGDES Minenergo joint board, D. Burenkov, a former worker at IVTAN:

"If there is success in realizing what was planned, the national economy will make a big gain. And even if it is not successful—what is so terrible? A half a billion? Small change in comparison with the expected outlook. Science requires sacrifices."

It would have been more logical to speak out on the advisability of sacrifices not for science in general (there is no argument there), but for the specific development to the leaders of the USSR Minenergo. It was namely it in 1982 which "made a hole" in the beginning of the preliminary work on the construction of the Ryazanskaya MGDES, it even took on itself the functions of producer of some of the custom-made equipment. But P.S. Neporozhnyy, who in those years was the minister of power and electrification, currently (after selection as a corresponding member of the USSR Academy of Sciences and retiring) is working at IVTAN. Such questions are still here.

At the USSR Minenergo the deputy minister A.F. Dyakov handles scientific-technical progress. He refused to meet with correspondents. Through an assistant he relayed that at this time he had nothing to say. Why? Whether up to now he had not looked into the situation, or is he waiting for reactions "from above"—what is there to conclude?

And just what is the result? There was the U-25 installation, on which, according to the words of the leaders at IVTAN, all the necessary test data were obtained for the transition to the commercial adoption of the MHD-generator. The expert commission of the GKNT stemmed from this, and although it renamed the MGDES as a commercial pilot plant, it retained its colossal volume inviolable, i.e., on the elephant's cage it hung the sign "hare," but it did not disturb the elephant. And then when it is necessary to implement the MHD-generator there is no working plant for it, but there is an idea for a new design. But the documentation has been prepared ahead of time and the appearance of a fresh thought today in no way influences the physical existence of that which should have been done yesterday. Doesn't that mean that the developers simply could not solve the problem, could not cope with the transition from an installation of 25,000 kilowatts to an MGDES with 580,000?

Many qualified specialists are certain that that is the way it is. At the IVTAN they told one of us about the results of the operation of the U-25. Almost two-thirds of its start-ups ended in breakdowns. Only once in 10 years was it possible to bring the time of continuous operation up to 250 hours. But the power was only three to four thousand kilowatts instead of the projected 25,000, and at night it dropped even lower. Thus the installation operated in a sparing way, which absolutely did not meet the requirements of the efficiency check. The projected power of the U-25 was not reached even once: the maximum—20,000 kilowatts, but only for several minutes and on maximum boost.

Is it possible to approach the development of a powerful MGDES with such results? Evidently it is necessary to examine the facts honestly, to continue investigations in order to assure the prolonged stable operation of the U-25 with rated indices. And only then to bring up the question of a major commercial project.

That is all. We hope that today the problem will finally be considered in essence, of the basis of facts, and not under conditions of the paradoxical phase of inhibition.

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Non-Traditional Technology for Working Deep Quarries

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[Article by Doctor of Technical Sciences A.G. Shapar and Candidates of Technical Sciences I.I. Gavrilyuk, V.T. Lashko, L.M. Solodovnik and M.S. Chetverik; the first paragraph is the authors' abstract]

[Text] The article examines the problem of choosing the most efficient technology for strip mining of solid mineral deposits. It demonstrates the progressive character of the so-called cyclic-straight line technology with partial or complete replacement of automotive or rail transport with conveyors.

Strip mining of mineral deposits has important technical and economic advantages over underground mining. In our country, approximately 80 percent of solid minerals are mined using this progressive method. Its share in the overall volume of mining of mineral resources will keep growing.

However, given the current status of the mineral and raw materials base and existing quarry stock, one must put in operation ever deeper areas, in order to ensure increased volume of mining. At present, an average depth of iron ore quarries in the Ukraine is 200-250 m, and it will soon reach 300-350 m.

In the case of developing steeply inclined deposits, a modern deep quarry is a huge man-made engineering structure: a pit in Earth crust and a high heap of dead rock at the surface. The pit volume is 250 million m^3, and the length of transportation communications in a quarry is 250 km. A quarry and its heaps, tailing dumps and industrial site occupy approximately 2,000-3,000 hectares. If current technologies are used, the condition of this land becomes such that it is unreal to return it back to agricultural use even in the long run.

As quarry depth increases, gas pollution of the excavated space increases sharply. Even now, in some quarries maximum permissible allowances for atmospheric pollution have been exceeded, which causes mining stoppages. There is also a serious problem of maintaining pit edges in stable condition. According to scientists' forecasts, at depths of 450-500 m and deeper the danger of occurrence of such phenomena as "rock bursts" sharply increases, and rock strength decreases after natural loads have been removed. Under these conditions, the very possibility of conducting strip mining becomes problematic.

As quarry depth increases, technical and economic indices of strip mining become much worse. The share of expenses for hauling rock mass in the total cost increases. Quarry deepening by 100 m results in 1,500-1,700 m longer roads for automotive hauling of rock (just for rock mass excavation, taking into account heap expansion). This in turn requires a larger number of vehicles and personnel and increases diesel fuel consumption.

Studies conducted by the Leningrad Mining Institute and Geotechnical Mechanics Institute, AN USSR [the Ukrainian SSR Academy of Sciences], (IGTM) have demonstrated that the maximum working depth for domestic automotive transport is 100-150 m. If the depth of excavation is greater, engines overheat and fail prematurely. In diamond mining quarries, for instance, one uses rock transfer from one truck to another inside a quarry as a way around the situation, so that for each vehicle the height of hauling does not exceed 150 m. As a result, at the current rate of quarry deepening (15 m per year) the efficiency of strip mining decreases by 5 to 25 percent annually. Under these conditions, technical and economic capability of modern technology based on utilization of cyclic (rail and automotive) transport cannot provide the required intensification of deposit mining and higher efficiency of the mining industry.

Integrated studies conducted by the IGTM and Mining Institute, Minchermet SSSR [The USSR Ministry of Ferrous Metallurgy], and experimental-industrial and industrial tests in Krivbass quarries have demonstrated that at the current stage an important trend in the technical progress in the mining industry under deep quarry conditions is to convert to a more progressive cyclic-straight line technology, with either partial or complete replacement of automotive and rail transport with conveyors. In this case, hauling distances for the most expensive means of transportation practically remain constant (1.0-1.5 km), with a 60-80 m depth slant pitch of transfer stations. The economic efficiency of this technology for quarries with an annual output from 10 to 35 million tons is approximately 2.0 million R a year.

Technological schemes of the cyclic-straight line technology are presented in the Table.

Technological schemes of cyclic-straight line technology with different types of transfer stations are shown.

The cyclic-straight line technology will develop in two stages. During the first stage, combined automotive-conveyor or rail transport and semistationary transfer stations with series-manufactured equipment will be

mainly used (Figure 1). For these technological schemes, service zones of individual means of transportation in a quarry can vary, depending on mining and geological conditions. The transfer station location changes accordingly. Basically, three types of locations are possible: on the surface, at the edge, and at the bottom of a quarry.

For Krivbass conditions, characterized by a steep-sloping position of the ore body, high parameters and rather intensive development of work with the depth, the combined transport scheme with the transfer station at the edge is the most efficient. As quarry gets deeper, the station is relocated periodically to a new concentration horizon. Station relocation with the depth makes it possible to use cyclic transport for short-distance hauling of rock mass.

Figure 1 shows the cyclic-straight line technology section in a quarry.

The scheme with the transfer station at the quarry edge can be used when there is a non-operational quarry edge and in the case of all moving edges. In this latter case, a conveyor complex is placed at a temporary non-operating edge, and after this edge is moved to the quarry boundary the complex is relocated to its permanent site. It is also possible to create a leading recess at the quarry edge up to its end contours; in this case, a steep ditch is built and a stationary conveyor lift that operates during the entire quarry life is installed in the recess.

When a quarry has weak edges and it is necessary to perform a large volume of work in order to build a leading steep ditch and develop mining in all directions, this combined transportation scheme can be implemented if a conveyor lift is installed in a gently sloping shaft located outside the boundaries of the quarry field. This scheme requires large capital expenditures and long quarry construction and updating time.

Experience of operating belt conveyors demonstrates that the can function normally if lump size of hauled rock does not exceed 400 mm. So, at the present status of blasting, rock mass must be prepared for conveyor hauling (by screening and/or crushing). The type of the quarry transfer station changes accordingly (screening, crushing, or screening-crushing).

When the cyclic-straight line technology with screening transfer stations is used, combined transport operates in accordance with the following principle. Blasted rock mass is brought in dump trucks to the transfer station located at the concentration horizon. On a screen, it is separated into subscreen (haulable pieces under 400 mm) product, which arrives into the hopper and is transferred from there by apron feeders onto an inclined conveyor and then hauled to the surface, and overscreen product (rock mass with lump size over 400 mm). The latter can be stored at the horizon and then hauled to the surface in a dump truck or by rail, or crushed at the transfer station using electrophysical or thermal methods or hydropneumatic rubble crushers, and then transferred onto an inclined conveyor.

When screening-crushing transfer stations are used in a quarry, the technological scheme of mining is simpler, because there is no need to haul overscreen product. Besides, in this case rock mass is better prepared for conveyor hauling. As a result, all rock mass brought to the transfer station is only hauled by conveyors. If the quality of blast rock crushing is unsatisfactory, crushing transfer stations are used. Usually, this is done when crusher productivity equals or exceeds the throughput capacity of the transfer station. If in blasted rock mass the share of fractions with lump size of over 400 mm does not exceed 10 percent, the use of screening stations is recommended; if this share is between 10 and 20 percent, it is recommended to use screening-crushing stations; and if it exceeds 20 percent, crushing stations are recommended.

Stationary and vibration screens can be used. At the IGTM, several types of stationary grate screens had been developed. They underwent experimental-industrial testing in iron ore quarries in the Ukraine. Heavy vibration screens are designed for installation at transfer stations with direct transfer of rock mass from high-capacity dump trucks onto the screen working surface. Such screens have several advantages over existing equipment operating under similar conditions: high productivity (3,000 tons per hour) and screening efficiency (90-95 percent).

Screening-crushing and crushing stations are equipped with various type crushers. Cone crushers KKD-1500/180 and KKD-1200/180 are heavy, so transfer stations that use them are cumbersome and expensive. The KKVD-1200/200 crusher designed by the NKMZ [Novo-Kramatorsk Machine Building Plant] and a cylindrical crusher developed by the IGTM are better suited for the application.

Experience of implementing cyclic-straight line scheme has demonstrated that capital expenditures for construction of transfer stations using cone crushers are substantial and construction time is long. Therefore, creating inside a quarry a mobile transfer station using a cyclic or continuous action excavator and a reloader with a vibration screen and a cylindrical crusher merits consideration.

At the second stage, when series production of self-propelled machines of various types and sizes will be mastered, technological schemes with conveyor lines installed in stopes will be widely used.

Main advantages of these technology schemes are as follows: concentration of drilling-blasting, excavation and hauling work by increasing the height of a worked ledge and reducing the number of transport horizons;

integrated mechanization and automation of main technological operations of rock mass excavation, hauling and heap forming; increasing production capacity of quarries due to mining concentration and intensification; improving sanitary and hygienic labor conditions in working deep quarry horizons, due to the absence of automotive transport in quarries, etc.

At the IGTM, new technological schemes with full conveyorization of mining and stripping have been developed for iron ore quarries. In essence, they operate as follows. At each working horizon, one set of machines consisting of an excavator, reloader and continuous transport equipment is used. From the excavator, rock mass is transferred onto the reloader where it is processed and transferred onto continuous transport equipment. Further hauling is similar to the earlier examined schemes.

The performed complex of work made it possible to define parameters of a system for working and stripping of lower horizons, solve an important problem of mineral averaging and substantiate technological parameters of equipment. It has been determined that reasonable theoretical productivity of the equipment complex is 1,000-1,400 m^3/hour, the width of excavator approach is 16-24 m, the width of reloader crusher feed opening is 1,000-1,200 mm, reloader hopper capacity is 28-34 m^3, conveyor belt width is 1.4-1.6 m, conveyor belt speed is 3.0-3.5 m/s and diameter of an average conventional lump of blasted rock mass is 170-180 mm.

Compared to combined automotive-conveyor transport, the use of technological schemes with belt conveyors makes it possible to reduce the cost of mining of mineral resources by 20-40 percent and increase labor productivity by a factor of 2.5 to 2.8.

In order to test the new technology, the country's first experimental-industrial section with full conveyorization of the stripping process has been created in an iron ore quarry at the Tsentralnyy Integrated Mining and Concentrating Works [TsGOK] (Figures 1a, 2, 6 and 3). It must be noted that heaps are formed in caving zones of underground ore mines, i.e., in areas that heretofore were considered lost. This solves one of the most important problems of reducing the loss of valuable agricultural land.

For these conditions, machine building plants have developed special equipment, such as excavators, stope conveyors, machine building conveyors, spreaders and heap conveyors. The section parameter are as follows: ledge height 24 m, stope front length 1,500 m, heap front length 600 m, the width of working area at the ledge 85 m and heap height 55 m (the length of the spreader heap cantilever 40 m). Capital expenditures for the section were equal to 15.0 million R, stripping cost were equal to 0.628 R/m^3.

Compared to the existing technology, the use of the new technology will make it possible to increase labor productivity by a factor of 2.8 and reduce mining cost by 35-40 percent. The process efficiency will improve sharply when manufacturing of continuous action excavators of the ERGS type, developed by the IGTM, is mastered.

Several Krivbass iron ore quarries and quarries in other mining subindustries already use the cyclic-straight line technology. It is also used in ore mining in a quarry at the Ingulets Integrated Mining and Concentrating Works with 36 million tons production capacity, at the Yuzhnyy Integrated Mining and Concentrating Works (18 million tons) and in the Annovskiy Quarry at the Severnyy Integrated Mining and Concentrating Works (18 and 10 million tons).

Figure 2 shows the experimental-industrial section in the TsGOK Quarry: a) excavating equipment and working conveyor; b) heap conveyor.

Figure 3 shows heap equipment and a heap conveyor.

A complex in Quarry No 1 at the Tsentralnyy Integrated Mining and Concentrating Works has been commissioned. Cyclic-straight line technology complexes re being built in Quarries No 3 and 2-bis at the Novo-Krivorozhskiy Integrated Mining and Concentrating Works and in a quarry at the Poltava Integrated Mining and Concentrating Works. By 1990, all Krivbass quarries will use this technology. Just in Ukraine iron ore quarries, the economic efficiency of its implementation will equal 15 million R annually.

The IGTM has completed justification of the new technology for Uzbekistan and Yakut quarries. Experimental-industrial testing and mastering of the cyclic-straight technology is Far North regions will make it possible to test technical solutions that efficiently involve in operation hardly accessible deposits in harsh climates. This will create the necessary basis for mastering the country's rich raw material base.

Successful implementation of the new technology in Krivbass quarries was a reason for its being selected as a general direction of mining of mineral resources at large depths. By the year 2000, 47.1 percent of chemical raw materials, 59 percent of asbestos and 20 percent of iron ore will be mined using the cyclic-straight line technology. In order to widely implement this technology in various mining subindustries, the Problems of Complex Utilization of Mineral Resources Institute, AN SSSR, IGTM, and Mining Institute, Minchermet SSSR, have defined equipment (conveyors, crushers, feeders, screens, etc.) needs and requirements for development of the machine building base. In all mining subindustries, the cyclic-straight line technology will make it possible by the year 2000 to reduce capital investment by 1.3-1.7

billion R and operating expenses by 1.4-2.1 billion R, increase labor productivity and free up approximately 200-280 thousand employees.

Still, the use of the cyclic-straight line technology in deep quarries does not make it possible to solve some acute technological, economic and ecological problems. The thing is that it is based on traditional principles: as mining gets deeper, the length of hauling increases. The cost of stripping increases accordingly, thus adversely affecting technical an economic indices. In addition, tremendous losses of agricultural land cannot be avoided.

Because of this, the IGTM is conducting research on justification of a non-traditional for the Krivbass conditions technology with internal heap forming. It involves layer-by-layer deposit stripping, wherein after excavation the stripping is refilled with stripped rock. When the lower layer is mined, one reexcavates the stripped rock that has been used for filling, mines virgin rock, again mixing it in the newly excavated space, etc. In mining mold-like Krivbass deposits, internal heap forming can be done without reexcavating the stripped work.

In order to scientifically justify the new technology, one must conduct integrated studies, including development of new methods for running main technological processes and controlling mining operating modes and rock mass status, as well as new procedures for determining the strip mining depth limit, taking into account economic and ecological effects of implementation of technical solutions.

The fact that the technology can be implemented in existing quarries without replacing mining and hauling equipment is advantageous. The IGTM has completed preliminary development of the new technology for certain quarries. It has been determined that implementation of the technology with internal heap forming will make it possible to reduce the range of rock hauling by a factor of 2 to 4, sharply reduce the number of dump trucks, diesel fuel consumption, and the number of employees. Gas pollution in the excavated space will drop sharply. And most important, 100-150 million m^3 of stripped rock will be put in internal heaps in each quarry. Thus, there will be no need to take approximately 1,000 hectares of valuable land out of agricultural use.

Just because of reduced direct expenses, the savings of reequipping a quarry will exceed 100 million R.

Thus, one can ascertain that non-traditional technologies of working deep quarries have been developed at the UkSSR Academy of Sciences organizations. These technologies ensure further expansion of the progressive method of strip mining of mineral resources.

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Characteristics of Exploration Targets for Ukrneft Production Association in Dneiper-Donets Basin

18610143a Kiev NEFTYANAYA I GAZOVAYA PROMYSHLENNOST in Russian No 1, Jan-Mar 88 pp 13-15

[Article by A.G. Demidenok, Ye.I. Soldatenko, N.I. Yavorskiy]

[Text] With progressively fewer relatively high-amplitude anticlinal structures - not long ago the principal exploration targets in the Dneiper-Donets basin (DDB) - the search for oil and gas in nontraditional prospects is acquiring more importance. Nontraditional prospects include small-amplitude folds, lithologically, stratigraphically, and tectonically sealed traps, and combination traps, occuring both as monoclines and as plunging limbs and periclines of large uplifts. These prospects are different in both genesis and morphology, and the problem of reliably preparing them for deep drilling by geophysical exploration methods has regretably not yet been solved. This circumstance has caused the lack of systematic and purposeful study of them.

Despite the significant variation of structural forms, an evaluation of their potential is meanwhile being conducted only on stratigraphic criteria, identifying principal and other directions for exploration.

For Ukrneft the principal trend in regional work is exploration and development of oil and gas reservoirs in deposits in the Lower Carboniferous and above the salt layers of the Upper Devonian. It was the development of reservoirs in these deposits during the 11th Five Year Plan that resulted in about a 90 percent growth in oil reserves and more than 95 percent growth in gas reserves in category C1.

Among the other trends within the graben are exploration and development of commercial hydrocarbon accumulations in deposits of the Lower Permian, Upper and Middle Carboniferous, intersalt and subsalt deposits of the Upper Devonian, and intrasalt continental carbonate sediments of the lower saliferous Upper Devonian series. Within the northern margin of the DDB and those parts of the graben adjacent to it, among these trends is the search for oil and gas deposits in wrenched crust and in zones of disintegrated Precambrian rock within basement protrusions in structural-tectonic zones of known oil and gas potential.

The stratigraphic principle for differentiating targets by degree of potential, which determines the direction of exploration and development, does not allow evaluation of the significance of different structural forms in the general scope of exploratory work and therefore does not express a preference for one or another structural form.

The diversity of prospects does not allow their classification by any specific qualitative characteristic. Because of the absence of a single correlation for all structures, we have made an attempt to distinguish their various types by an aggregate of characteristics. Each of these types embraces traps similar in structure and genesis and confined to a specific structural-tectonic zone of the DDB. Correspondingly, methods of exploration and development in these groups of prospects must have distinguishing features which take into account the specifics of the group. The principal features for each of our chosen four types of non-traditional oil and gas exploration targets are given in the table for Ukrneft conditions.

The first type groups small-amplitude folds, on which exploration for oil and gas is conducted within the central graben and the basin margins. This exploration trend has been traditional from the first years of development of the region. As the number of large anticlines was exhausted, geophysical methods of discovering small-amplitude folds were improved. During the 11th Five Year Plan Ukrneft conducted exploratory work on 13 small-amplitude folds. Commercial flows of oil were observed in one area. The majority of prospects produced negative results or noncommercial flows.

Almost all the prospects of this group, formed for the most part with the active participation of salt tectogenesis, have amplitudes up to 25 meters; in area, as a rule, they do not exceed 5 square kilometers. These structures follow along Lower Carboniferous or Devonian post-salt deposits with which the chief prospects for new oil and gas deposits are associated. Almost all the structures of this group are complicated by dislocations with offsets of 20 to 150 meters, which makes their evaluation more difficult. The average number of drill holes for evaluating and developing these prospects is 1.4 (see table).

The second type includes prospects representing sections of monoclinally deposited rocks. The Sorochin, Belousov, and Slavkov areas belong to this type. Block tectonic activity in these areas led to discontinuities in sediment accumulation and, as a result, to the stratigraphic pinchout of part of the productive layer, as well as to the widespread development of dislocated ruptures and formation of lithologically sealed traps.

Commercial flows of gas with condensate from traps of the second type have been obtained at the Belousov area (even during the 10th Five Year Plan). At the first Sorochin area, the survey of discovered deposits has been completed, while at the second work continues. In the Slavkov area deep drilling has been discontinued because the well drilled here failed to establish the presence of commercial hydrocarbon accumulations; however there are vigorous gas shows.

Showing sufficient potential, but less well studied, are prospects of the third type, which are located on the slopes of the northern margin and in the fractured zone of the DDB. The sedimentary cover here is missing the Devonian, the Tournaisian stage, and Lower Vizian substage of the Lower Carboniferous. This type includes prospects classified as small-amplitude folds (Chernetchin structure in the Budnov-Chernetchin area) and nondomal and combination traps (for example the Budnov structure in the Budnov-Chernetchin area; the Ul'yanov, Pavlov, and Nikitov structures in the Ul'yanov-Nikitov area). Potential oil and gas bearing deposits are not deep (down to 3000 meters), which stimulates the progress of exploratory work. The chief oil and gas potential here is associated with the Upper Vizian formations.

Structures of the third type are different in genesis from structures of the second type in as much as they are located in other geologic conditions, and were formed without the participation of salt tectogenesis. The Radyan and Kudryav areas also belong to this type. Prospects of this type, located in the hinge zone between the basin and graben, are usually leaning toward the regional marginal dislocation structures, which have been influenced both by the graben and by the basin margin. Work on structures of this type has been conducted for a long time. At some of these, like Domalenkov and Gurbintsev, drilling has been suspended, because they have given negative results. No commercial flows of oil or gas have been obtained from prospects of the third type during the 11th Five Year Plan.

The fourth type of exploration targets are subsurface limbs and periclines already explored in the crest of large folds which have known deposits of oil and gas.

This trend in exploration includes the limbs and periclines of the Glinsk-Rozbyshev, Rybal, Kachanov, and Klinsko-Krasnoznamen folds, as well as the Romashov and Dolgopolov areas, located correspondingly on the northwest pericline and southwest limb of the Veliko-Bubnov uplift.

A feature of prospects of this type is that their formation was significantly influenced by salt tectogenesis, which in combination with periodic oscillating tectonic movements in the DDB was the cause of the extremely complex structure and the development of stratigraphic and angular unconformities characteristic of the various lithologic-stratigraphic complexes. Structures of the fourth type are usually complicated by a system of variously trending faults, forming a series of tectonic blocks. All this creates multiple tectonic, lithologic, and stratigraphic traps.

The principal exploration targets for oil and gas in structures of this type are Lower Vizian and Tournaisian deposits of the Lower Carboniferous, as well as postsalt sediments of the Upper Devonian, partly or fully eroded in the crests of anticlinal folds.

During the 11th Five Year Plan targets of this group have yielded positive results in the Romashov and Klinsko-Krasnoznamen areas and negative results in the Dolgopolov area.

To a separate subgroup might be assigned traps in which the oil accumulations are controlled by subregional disjunctive faulting lying close to known fields, Bugrevatov and Koziev in particular. Some traps of this group, developed principally in postsalt Upper Devonian, might be ascribed to tectonic sealing; the others to combination structural-tectonic sealing (if they were formed by semi-crests, slanted towards the subregional fault). Determination of the sealing role of the above-mentioned subregional fault allowed the production association to carry out purposeful exploration work in the Bugrevatov and Koziev fields during the 11th Five Year Plan.

Exploration for oil and gas deposits in rocks of the crystalline basement presents a problem. The potential of prospects confined to local projections of crystalline basement is made evident by production under these conditions in the Khukhrin area. However large-scale drilling operations in this direction have not been prepared.

Analysis of results from exploration work during the 11th Five Year Plan allows us to draw the following principal conclusions.

1. Exploration for commercial accumulations of hydrocarbons in small-amplitude anticlinal traps has turned out to be minimally effective. The cause, possibly, is that some of the seismic maps of traps have not been corroborated by drilling data, and that the small-amplitude anticlinal structural forms do not play the role of traps, in other words they cannot confine hydrocarbon accumulations. Because of this it is essential to increase the quality of preparation of similar prospects, as well as to conduct research aimed at determining the lower limit of amplitude for a trap capable of confining hydrocarbons.

2. In sections of monoclinally bedded rock (Belousov and Sorochin areas) gas and condensate accumulations were discovered by parametric boreholes, that is they were not discovered by intentional exploration. Development of the discovered deposits has entailed difficulties and large exploratory drilling footage, since for its success it is necessary to have at one's disposal information not only on the target's structure, but also of the nature of the spatial arrangement of the reservoir beds. The absence of sufficiently reliable information about this prohibits widespread exploration in other areas.

3. Oil and gas exploration in the hinge zone on the northern margin and the marginal zone of the basin might be successful if conditions can be found with either anticlinal folds of amplitude greater than 50 meters, or nonfolded (nonanticlinal) traps in places adjoining a regional deep fault where silt desposition has occurred.

4. The effectiveness and productiveness of exploration aimed at finding oil and gas reservoirs in limbs and periclines of large uplifts grew significantly with reliable mapping of nonanticlinal traps and primarily stratigraphic traps in Lower Carboniferous and Upper Devonian deposits.

5. In order to determine the capability of subregional fractures to control hydrocarbon accumulations, it is necessary to conduct detailed hydrodynamic studies primarily in the marginal regions of the basin.

6. To widely expand exploration for oil and gas in the rocks of the crystalline basement is unfeasible for now in view of the lack of a work plan prepared by purposeful regional and detailed studies which take into account the exploration experience in the Khukhrin field.

Thus, in order to conduct exploration and development successfully in the DDB it is essential not only to increase the quality of preparation of structures for deep drilling, but also to have information on the spatial extent of reservoir rock primarily in the deposits of the Lower Carboniferous and postsalt Upper Devonian.

Increasing the quality of preparation of structures for deep drilling (especially in nontraditional targets) is achieved with the help of more modern methods of seismic surveying, including, besides OGT [common depth point] methods with high overlap ratios (48-96), methods of simultaneous recording along longitudinal and nonlongitudinal profiles and "wide profile" methods. It is also necessary to complete the transition to areal seismic exploration, which, as a result of studying geologic structures in three dimensional space, makes possible the discovery of more small structures, rifts, microhorsts, wedges, fault dislocations, paleochannels, and other things.

To get more information on the spatial extent of reservoir rocks it is necessary to use classic geologic methods together with the newest seismostratigraphic type geophysical methods and to process the data with geologic section forecasting programs (PGR).

12805

MHD Research Criticized, Concrete Results Sought

18610148a Moscow STROITELNAYA GAZETA in Russian 4 Feb 88 p 2

[Three articles under collective title "Returning to What Has Been Published: Hypnosis of Golden Promises"]

[Text] An article under this title was published in SG [Stroitelnaya Gazeta] on 31 October 1987. It argued that the construction of the Ryazan magnetohydrodynamic electric power station (MGDES) at a cost of about half a billion rubles was begun without sufficient engineering, technical, and economic justification. The deadline established by the governmental assignment for construction and start-up of the station by 1989 has not been met. The developer of the MHD generator, the High Temperatures Institute (IVTAN) of the USSR Academy of Sciences has not yet issued the documentation for the main unit of the station.

We are including official answers to the newspaper article by GKNT [State Committee for Science and Technology] and IVTAN and also commentaries from the editorial department.

High Temperatures Institute of the USSR Academy of Sciences

[Article by V. Batenin, acting director of IVTAN; A. Sheyndlin, general designer of the MHD unit, academician; V. Shikov, secretary of IVTAN party committee]

The article "Hypnosis of Golden Promises" was discussed at an enlarged session of the party committee of IVTAN including the leading specialists of the Institute who are participating in the construction of the experimental-commercial MHD power unit at the Ryazan GRES.

It is noted that the situation in the construction of the MHD power unit set forth in the article and a number of the facts about its construction on the whole corresponds to reality. However the article's portrayal of facts and the explanation of the situation which has arisen in the construction of the power unit is, according to the opinion of the party committee, the directorate, and the specialists of the Institute, entirely one-sided.

The authors of the article did not touch on the real reason for the exacerbation of the situation with the power unit's construction. In connection with this we consider it essential to set forth our position on the questions that have been raised.

First of all we point out that from the point of view of the Institute's specialists, the "U-25" unit and other test units provided basic experimental data essential for the design and construction of an experimental-commercial MHD power unit.

IVTAN's management and specialists made, in our opinion, an entirely justified decision to propose to build an MHD power unit on the basis of the existing experimental material and at the same time to continue to work for progress in the necessary service life of the channel firewall. This proposal was supported by the USSR Minenergo [Ministry of Power and Electrification], GKNT, and the USSR academy of sciences and in the end was accepted. The work was continued on a special unit of the Institute, "U-25BN", and on a unit of the USSR Minenergo, "U-02".

The correctness of this decision has been confirmed by the attainment in 1986 of a 440 hour firewall service life on the "U-25BN" and, in October, 1987, of a 800 hour continuous operation firewall service life on "U-02" under conditions characteristic of channel operation on the MHD power unit. This service life is already close to the recommendations of the State's committee of experts. Moreover the service lives of the two types of wall were not exhausted.

But the question broached in the article is in essence a question about whether we should build basically new equipment while having a definite lack of knowledge, taking a conscious technical risk, trusting in the specialists who are taking the responsibility on themselves? The history of technology has many times answered this question positively. However, judging by the content of the article, the authors wittingly or unwittingly answered it negatively.

We cannot agree with the opinion that the broken deadlines of the MHD power unit construction are explained by the lack of underlying data and by the general designer's May, 1987, proposal for a new type of magnetic system. First of all the shortfall in construction and installation work which occurred in 1985/86 amounted to about 45% of the plan. At the present time there is issued but unfulfilled documentation for more than 60 million rubles of construction/installation work while at the same time the volume of work planned for completion in 1988 amounts to less than 20 million rubles.

The main issue in the construction of the magnetic system (SPMS) was not reflected in the article. The enterprises of the USSR Ministry of Ferrous Metallurgy did not supply on time the special steel for the manufacture of the heavy framework and will supply it only in 1988. This shifts the date for the construction of the magnetic system to 1992. In connection with this, leaning on the scientific research continuing at IVTAN, a proposal was made according to the established procedures for the very same date, that is in 1992, to develop and manufacture a new type of magnetic system, which according to the opinion of the specialists is more promising.

In accordance with the mission to IVTAN and to the general designer - the Moscow branch of the Thermoelectric Planning Institute (MOTEP) the development of the technical design of this magnetic system is now being carried out. Its technical design will be judged according to the established procedures by specialists and presented for approval.

The development of a new SPMS is not a hinderance and will not continue the construction delays since, according to the data of the general designer, the foundations which have been laid down are adaptable to the new SPMS as well and the working documentation issued by the general designer essentially needs no corrections.

Unfortunately, instead of an objective analysis of the situation with the supply of materials and manufacturing of the SPMS, and with the failure of the construction workers to meet the deadline, in the SG article the Institute again turns out to be the accused. Finally, the economic value of the experimental-commercial MHD power unit ought to be decided. It is being constructed with the deliberate use of a number of forced technical decisions which lower its economic characteristics due to the use of standard equipment not fully suitable for optimal operation of the unit. The first model of newly created equipment, naturally, always has a high cost. All this is normal and hardly unknown to the authors of the article and cannot serve as a cause for revision of the estimated efficiency of mass-produced MHD power units. The experimental-commercial unit is the very one that must become in essence a large-scale testing ground for the final development of new equipment, some of which, unfortunately, it is impossible to finish developing on smaller-scale units. We note that on the power unit being built, which is gas-fueled, sixty percent of the equipment used for coal-powered MHDESs is also being developed.

We must admit that IVTAN, in carrying out a work of such complexity and multiple plans, which the construction of the Ryazan power unit is, requiring the combined efforts of enterprises of many ministries and departments, allowed certain miscalculations and mistakes. They were openly and critically discussed at the enlarged session of the party committee of the Institute.

Thus for example the cooperation with the general designer - MOTEP - was inexact on a number of issues. The Institute did not fully use the alloted time and the experimental base.

One cannot consider the completion of such a large-scale industrial project as the construction of the MHD power unit to be the business of just one institute of the Academy of Sciences. This problem can be solved only through the combined efforts of all participating organizations and primarily with the serious interest of the USSR Minenergo. But so far (and the content of the published article attests to this) departmental interest is winning.

The authors of the article, justifiably focusing attention on the state of affairs at the construction of the MHD power unit, could not, unfortunately, correctly evaluate the situation and give an objective analysis of the circumstances, but the most important thing is to draw valid conclusions about the prospects of developing the MHD method of energy conversion.

USSR State Committee for Science and Technology

[Article by M. Kruglov, assistant chairman, GKNT]

Work in the field of MHD conversion has been done over the course of almost a quarter century. A number of experimental MHD units, including the "U-25" unit, have been built. Experiments on a number of variants of the most important MHD generator elements have been done on it. These include four types of combustion chambers and five type of MHD channels and others.At the same time these experiments did not provide data essential for making final decisions on the structure and capacity of the main elements of the MHD generator. In 1983 the "U-25" unit was shut down for reconstruction work.IN 1984 the State committee of experts of the USSR State Committee of Construction, GKNT, and the USSR State Committee for Pricing examined the technical design of the Ryazan MHD power station and approved it, making at the same time a number of key criticisms. Keep in mind that at the beginning of construction of the Ryazan GRES MHD generator these criticisms will have been allowed for in the plan. Nevertheless at the present time there remain very important unsolved technical problems with the operational reliability of the MHD generator. In particular the technical design of the MHD generator has not been confirmed by the necessary comprehensive MHD channel experiments recommended by the USSR GKNT for establishing its capability for long-term continuous operation consistent with the demands of stationary power engineering. Moreover in the course of developing a working design for the Ryazan MGDES MHD generator it became necessary to conduct an additional series of scientific investigations and developments for selecting a superconductor magnetic system, which is one of the basic and complicated elements of the unit. On the basis of this work changes in the technical design of the MHD generator may be needed, requiring a second committee of experts.The construction of the experimental-commercial Ryazon MHD power station is being conducted by units of Minergo with significant failures to meet the deadlines and volume of work established by the decisions of the government.All of this testifies to the accuracy of the questions raised by SG.The USSR GKNT has developed a series of measures on the topic of MHD power stations and has introduced corresponding proposals into its management bodies. These proposals are aimed particularly at the quickest possible completion of the series of additional scientific investigations and developments.

Commentary by the Department of Scientific and Technical Progress of SGWe

We remind you that one answer to the article "Hypnosis of Golden Promises" - from Minenergo, written by assistant minister A. Dyakov, has already been published (16 Dec 1987). It stated that "the status of design and construction work on the MHD power station was correctly reflected in the newspaper. The Ministry also agrees with the paper that the construction of a facility of such scale and purpose was begun in due course without critical appraisal of the experimental results and possible technical and economic modeling methods. A comparison of the principal technical and economic factors of the MHD conversion with modern steam-gas facilities and steam turbine power units shows that it does not offer substantial advantages for its significantly more complex equipment".The management of the High Temperatures Institute appraised the stuation differently. First of all they do not agree with the statement that "the failure to meet the construction deadline of the MHD power unit is explained by the lack of underlying data and the proposal set forth in May 1987 by the general designer for a new type of magnetic system". This clearly means that for a year before the planned start of the MGDES the developers have not yet presented either a working design or the technical conditions (technical assignments) for the MHD generator, in other words for that part of the station for whose sake the whole work is being done. However in the opinion of V. Batenin, A. Sheyndlin, and V. Shikov, it is possible to build even without a design for the main unit of the station, all the more so since the builders have unfulfilled documentation."The documentation issued for the MHD part of the power unit is not suitable for realization", says the chief engineer for MGDES design of the Moscow branch of the Thermoelectric Institute, A. Bryskin. "It is impossible to build something which you have no conception of. The general designer unilaterally virtually cancelled the design which had been approved by the directing organizations. The underlying data for the working design which the developers were supposed to give in 1986 is still lacking. To be brief, until they present a technical design, and one which is approved through the established procedures, there can be no talk at all about any kind of design or construction."Now about "the main question" of the creation of the magnetic system which "was not reflected in the article". In IVTANs reply it is stated that "the enterprises of Minfermet did not supply on time the special steel for the manufacture of the heavy framework and will supply it only in 1988. This shifts the date for the construction of the magnetic system to 1992". As if in this connection a proposal was even made "for the very same date, that is in 1992, to develop and manufacture a new type of magnetic system".But it has long been known that the specialty steel for the framework will arrive in 1988; how could this hinder IVTAN's development of the technical documentation for the MHD generator, which represents a whole set of equipment? Moreover it was necessary, of course, to issue this documentation significantly earlier than 1987 when the general designer made the proposal about the new type of magnetic system.But that's not all. The management of the Institute, alluding to the fact that the steel will be forthcoming only this year, promise to develop and manufacture a new type of system for 1992. Consequently, the use of the ordered metal is referred to. But in fact the metal volume of the new design is much higher; it requires much more steel than was ordered. What kind of manufacture of magnetic systems "for the same date" can one talk about?In their attempt to shift the blame for the stalling of a widely acclaimed development onto someone else the authors of the reply did not cite even one convincing argument. Or are they preparing the ground to raise the "main question" again sometime in 1992? By the way, about that time frame. The Ryazan MGDES consists of two units: the MHD generator where the direct conversion of thermal energy to electric power takes place, and the steam generator which works on the heat of the gases coming from the main unit. The gigantic steam generator is practically already built. In the absence of the MHD part it can operate independently on natural gas. However the cost of each kilowatt-hour it produces is five times higher than the average one in thermal power engineering. The operation of the steam turbine unit will bring the government annually 40-50 million rubles of pure loss. This amounts to half of the cost of the entire steam turbine unit. Thus every two years the country will lose a sum which is enough to build a standard power unit with a capacity of 800 thousand kilowatts.Let's make the simplest calculation. The managers of IVTAN assure us that the MHD generator will be ready in 1992. Over five years (we will take this figure overlooking its very small likelihood) it is suggested that the government "for no particular reason" lay out 200 to 250 million rubles (the cost of a large power station), instead of using the money in any indisputably effective manner. And for whose sake? The managers of INTAN indirectly answer this with the help of a rhetorical question about the "concious technical risk". Of course a risk is a noble thing. But only if you risk, so to speak, on your own account. If you win, hooray for you. If you lose, pay up. Nothing of the sort is observed in this case: all the consequences of loss are shifted onto society. In IVTANs reply they do not mention one word about the "economic effect" of the proposed shifting of the date for the station's start-up.The official reply does not clear up even one of the questions arising from an aquaintace with the history of the Ryazan MGDES. Let us recall them. Why, having spent great resources and long years on the development of the MHD generator, having achieved the start of construction for a huge expensive project, does IVTAN in the very last moment announce that it does not have a working design, but does have an idea for a new design which will require another five years to complete? Why did they undertake the construction of the MGDES on natural gas at all, when, in the opinion of all the specialists, including even those of IVTAN, only hard coal is economically suitable for use as fuel? All of this is surrounded by silence. Several words about the reaction of the presidium of the USSR

Academy of Sciences [AN]. As the assistant to the president of the AN, T. Melnikov, reported to us, vice-president Ye. P. Velikhov was assigned to give an answer to the paper on the article "Hypnosis of Golden Promises". On December 10 they called from the presidium of the AN to the editors office, apologized for the delay in the answer and promised to send it December 14. However they did not send it. At the beginning of January the editors office tried to contact the vice-president. His assistant, G. Tokareva, stated that comrade Velikhov instructed her to pass on: the answer to the editorial office of SG will be given...through another newspaper (which newspaper was not indicated).Thus there is direct evidence of an attempt to establish a new method of answering readers of one newspaper with the help of another. A unique case, you must agree. In this respect one might compare it to the history of the construction of the Ryazan MGDES itself.We await the development of events in this direction with impatience.

12805

User Apathy Delays Production of Firefighting Robots for Nuclear Plants

18610163c Moscow PRAVDA in Russian 9 Mar 88 p 3

[Article by Yu. Gorban, head of a group for development of firefighting robots (Petrozavodsk)]

[Excerpt] The first Soviet firefighting robot, which was developed in Petrozavodsk, was intended for protecting the world-famous monument of wood architecture in Kizhi, since a conventional drenching system met neither aesthetic nor technical requirements.

The use of firefighting robots is a particularly urgent matter at nuclear power stations where hand-held high-pressure fire hoses are installed in machine rooms, for example. This equipment is extremely dangerous or simply impossible to work with in emergency conditions. According to instructions, firemen are supposed to use the hoses to cool machine rooms' ceilings, which can collapse in 3 to 5 minutes during a fire. In conditions of heavy smoke and poor visibility, such operations could be performed easily by a firefighting robot which had been programmed in advance.

In response to a telegram from the USSR minister of internal affairs, a firefighting robot was rushed from Kizhi to the Chernobyl Nuclear Power Station in 1986. Another three robots were built simultaneously in 3 weeks. V. Galushchuk, deputy chief engineer of the Chernobyl station, said in praise of these robots: "They made it possible to perform a significant amount of work in conditions of heightened risk. We consider the solutions that were selected to be correct and highly promising."

Now that the Main Administration for Fire Prevention and the All-Union Firefighting Scientific Research Institute of the USSR Ministry of Internal Affairs are rendering full assistance to work on development of robots and taking part directly in these projects, the Main Administration for Special Automation Equipment is ready to organize series production of these products, and numerous requests for employment of robots are being received, auspicious conditions would appear to have been created.

But the clients—the ministries for which the robots are intended, particularly the Ministry of Nuclear Power Engineering—have displayed an indifference that is incomprehensible. While agreeing that firefighting robots must be used, the heads of these agencies think for some reason or other that they need not hurry to begin financing their production; after all, 4 million rubles are needed to launch series production of the robots. That a number of imported robots for the Chernobyl station cost several million rubles at the going rate of exchange is at least worth remembering.

/9604

T-15 Tokamak: Current Status, Hopes for 1988 Startup

18610172b Moscow NTR in Russian No 4, 16 Feb-7 Mar 88 p 8

[Interview with B. Stavisskiy of the Institute of Atomic Energy imeni I.V. Kurchatov by V. Pokrovskiy: "When Will the Tokamak Be Built?" first paragraph is introduction]

[Text] I came across a communication "Another Step Toward Thermonuclear Fusion" in NTR (No 1, 1988), where the T-15 tokamak was discussed. As I recall, I have read this classical headline in the newspapers. I especially looked for SOVETSKAYA ROSSIYA for 1980, since the article on tokamaks in that issue was titled "Just a Little More, Just a Little Bit Further." Instead of thermonuclear fusion, some kind of far horizon is seen. We are always moving forward. It probably took less time to build Cheops pyramid than to build this T-15. Tell me truthfully, when will it actually be started up? I. Falin, engineer, Novosibirsk.

The analogy to a distant horizon is losing its timeliness with respect to the T-15. It's as if the epic of its construction is finally approaching an end. A conversation with B. Stavisskiy from the Institute of Atomic Energy imeni I. V. Kurchatov, one of those who will supervise installation of the unit, convinced us of this.

[Question] What then is the T-15? To what extent is construction of it bringing physicists closer to their cherished goal—startup of the first thermonuclear power plant? What is its position among similar Western installations?

[Answer] "To talk about the similarity of the T-15 and the leading foreign tokamaks (TFTR in the United States, JET in Western Europe and JT-60 in Japan) would not be quite correct," B. Stavisskiy feels. "Each country is proceeding toward the goal on its own path and, therefore, each installation, including the T-15, is unique. Repeating the parameters achieved in other tokamaks according to certain aspects, the T-15 has differences that make it unique in its own way. Thus, superconducting magnetic windings of niobium-tin alloy were first used in it to create a toroidal magnetic field. Added to this, heating the plasma with SHF waves, developed by the Institute of Atomic Energy jointly with the Gorkiy Institute of Applied Physics, was used in the T-15. It has a number of advantages over other methods of heating. A record electron temperature—100 million degrees—was achieved in 1987 by using this method in the T-10 tokamak, operating at IAE.

Thermonuclear research is not only and even not so much a purely scientific joining of theory and experiment, but is development of new technologies, instruments, tools and materials . Development [sozdaniye] of a tokamak reactor that generates electric power is a long multistep process of a gradual increase of the dimensions

and magnetic fields of experimental installations and of plasma temperature, density and lifetime. In short, parameters sufficient to maintain a thermonuclear reaction will be gradually reached. The T-15 in this chain is an important step before startup of an experimental industrial installation.

The goal of developing it is to produce and study a plasma with thermonuclear characteristics, i.e., with a temperature of 100 million degrees at the center of the plasma column and with plasma density of (2-3) times 10^{14} particles per cm^3. Complete information about the physics of a thermonuclear plasma is required as soon as possible. These data are required in design of the next generation of tokamaks—an experimental thermonuclear reactor (OTR). We must also study ways of handling the thermonuclear plasma, optimize methods of heating it, the startup phase and extinction of the discharge, and we must accumulate experience in operation of the subsystems of the installation. In short, the T-15 will permit us to solve most problems faced by installations of its generation.

But there are also restrictions: the problems related to the behavior of a tritium plasma remain unsolved (hydrogen with deuterium additives will be used in the T-15 instead of a deuterium-tritium mixture, required for an industrial reactor). The difficulties of working with diverters—devices for removal of combustion products and impurities from the reactor zone—must also be solved, although diverters will not be used in this tokamak.

[Question] How will will these problems be solved.

[Answer] There is more than one tokamak in the USSR. There is a group of smaller installations, specifically, at our institute. Let us say, there is a tokamak with a strong magnetic field (TSP), developed at a branch of IAE, for experiments with a tritium plasma. Its physical startup was at the end of December of last year. Moreover, much information is coming in from abroad.

[Question] As I understand it, the main data which you expect to obtain on the T-15 will come from those who already have tokamaks of the given generation. Why duplicate them.

[Answer] Of course, one can read articles or hear in reports how things are at the TFTR or JT-60 tokamaks. But each national program and each tokamak is unique. Although the physics is identical throughout the world, its laws may manifest themselves differently even in similar installations.

This is true of physical data. And if we are talking about technology and engineering problems, it is simply impossible to base this on foreign experience. I understand your question thusly: is the T-15 generally necessary? Would it not be better, relying on foreign data, to begin construction of an experimental thermonuclear reactor immediately? No, of course not. Development of the T-15 and experiments on it are necessary and they are a compulsory part of the national thermonuclear research program.

[Question] The T-15 was first discussed at the end of the 1970's. Why is there such a long delay in construction of it.

[Answer] There are two main reasons that the T-15 was "delayed" compared to foreign installations. They are both interrelated. First, there was the purely technical complexity of the installation and the need to solve a lot of non-traditional engineering and technological problems. For example, new superconducting material, powerful helium liquifiers, high-vacuum pumps and so on were developed especially for the T-15. This forced us to "scatter" different assemblies among a number of enterprises. Very many of them were accumulated: there were approximately 30 enterprises among which the contribution exceeded 1 million rubles. Among them are the Scientific Research Institute of Electrophysical Apparatus imeni D. V. Yefremov, which is simultaneously emerging as the main designer of the T-15, the P/O [Production Association] Elektrosila, P/O Atommash, NPO [Scientific Production Association] Kriogenmash and NPO Burevestnik. This includes various plants, various institutes, various ministries and even various countries—Hungary and Czechoslavakia.

And over all these years, there has constantly been someone who was unable to meet the deadlines. Of course, not because these enterprises did not want to build the T-15. It was simply very complicated to develop and manufacture, especially its superconducting part.

Moreover, and I feel that this is the second main cause, the orders for design and manufacture of various assemblies of the T-15 were assigned to the enterprises "from above," in addition to already available plans. The real capabilities of the enterprises were obviously not always taken into account. That is sometimes why there was a struggle to allocate these orders and subsequently to fulfill them.

The main work on manufacture of the equipment is now behind us. The phase of work related to testing the superconducting units has also been completed successfully. But, although there is now the real possibility of preparing the T-15 for physical startup in 1988, you must understand clearly that this requires intensive efforts of many collectives—participants in development [sozdaniye] of the T-15.

6521

AES Conference Evaluates Future of 5 Nuclear Plants

18610180 Moscow STROITELNAYA GAZETA in Russian 30 Mar 88 p 1

[Article by L. Komarovskiy, STROITELNAYA GAZETA special reporter, "Painful Spots: Report From Conference Call Meeting That Examined Situation with Construction of Five One-Million-kW Nuclear Power Units Which Must Be Commisisoned This Year"]

[Text] The Chernobyl disaster has forced us to look at nuclear power plants, and first of all at their construction quality, in a new way. Obviously, the country's development is impossible without nuclear power. This means that construction of nuclear power plants must be reliable and 100-percent guaranteed.

This year, four existing nuclear power plants must increase their capacity by 1 million KW each and start-up of the first million kW unit is scheduled at the fifth one, the Rostov AES. Never before had construction workers to be ready for commissioning five nuclear power giants at the same time. This is not just a complex problem, it is an unprecedented of one.

...As usual, meeting participants take their seats in the conference call room at Minenergo SSSR [USSR Ministry of Power and Electrification]. At 3 p.m. sharp Glavstroy Deputy Manager A. Nikulin calls up the first construction site, the Yuzhno-Ukrainskaya AES, where commissioning of the third power generating unit is scheduled. My dictating machine is recording the report by General Contractor Administration Manager N. Stulin.

"As to the situation in the reactor room: walls are at the 49 m elevation, to be completed February 15, or approximately 2 months behind schedule; installation of cornice structures is to be completed April 30, also behind schedule. In both cases, the reason is work force shortage. The turbine will be enclosed in July, on schedule."

Stulin lists items in the start-up schedule. Most of them proceed on schedule and do not cause any special concern. But when it comes to equipment deliveries, faint alarm notes are appearing in the heretofore calm progress of the meeting. Stulin lists the items and receives comprehensive answers regarding every item. The customer representative, Deputy Manager, Glavenergokomplekt, Minatomenergo SSSR [USSR Ministry of Atomic Energy], V. Gorodenskiy gives detailed explanations on how and when bottlenecks will be widened.

It looks as if Stulin is satisfied with everything except...

"The June delivery of thimbles from the Zhiguli RMZ [repair mechanical plant] is absolutely unacceptable. This threatens the AES schedule."

Thimbles are multiton metal structures. They are needed right now, but here it is, delivery interruption, and it causes a fully justified alarm. A. Nikulin sums it up:

"We shall discuss with you later how many thimbles you need right away, and we will make every effort to move the deliveries closer."

Current problems have been identified, and I am given an opportunity to ask Stulin about preliminary first quarter results.

"The overall construction plan will be fulfilled at 108 to 110 percent", Stulin replies. "Installation organizations will overfulfill plan even more, by approximately 15 percent. Moneywise we will have mastered around R500,000 above plan. It is realistic to commission the unit this year, although it would be very difficult to accomplish. According to standards, it should be commissioned in 1989, but we pledged to commission the one-million-kW unit this year, and we intend to keep the pledge."

N.Stulin signs off, and A. Maksakov, Manager of Saratovgesstroy, is on the line. The collective he manages must commission the third one-million-kW unit at the Balakovo AES.

"The situation is as follows. All in all, we need R163 million worth of equipment. At present, we are only R1.346 million short, less than one percent, but this holds back about 30 percent of work. Although we will fulfill the first quarter plan moneywise, the unit start-up schematic is behind schedule, and we are already one month behind on a number of jobs. We should have started washing the systems on February 22, but even today we are not ready yet to perform this important operation.

An order to make up for delays in equipment deliveries has been drafted and sent to Moscow on March 5. The deliveries were scheduled for March. Somebody has been sitting on the document for a month already, but it has not been signed and, naturally, nobody is following it. There is virtually no progress. Mintyazhmash SSSR [USSR Ministry of Heavy and Transport Machine Building] has delivered 3 out of 9 items listed in this document, Minelektrotekhporm SSSR [USSR Ministry of Electrical Equipment Industry] - 2 out of 21, Minkhimmash SSSR [USSR Ministry of Chemical and Petroleum Machine Building Industry] - 5 out of 21, Minenergo SSSR - 0 out of 10 and Minatomenergo - 2 out of 46.

Today it is quite obvious that if deliveries are made at this rate, we will not be able to commission the unit next year, let alone in 1988. During the first quarter we had to commission four facilities, but we are unable to do this because equipment is not available. Scheduled commissioning of 10 facilities in the second quarter is also threatened. If all equipment is not delivered by mid-April, we will not be able to commission the unit. Late

deliveries will result in rush work, and under these conditions one cannot assure proper quality. We do not have the right to and will not sacrifice the quality and reliability of the power generating unit."

The report is clear and specific. Meeting participants advise the Balakovites as to what equipmewnt and when will be shipped. But I feel that they are uncomfortable: a serious order mentioned by Maksakov has been filed away somewhere.

Now V. Stepanov, Production Department Manager, the Zaporozhye AES Construction Administration, is on the line:

"All first quarter itemized targets have been met. Foundations, machine room cranes, the deaeration stack etc. have been presented for instgallation. I have mainly questions for Minatomenergo. I heard the Balakovo AES. Our equipment situation is the same. Or maybe even worse."

Stepanov lists specific items and gets answers. Checking the minutes of the previous meeting, I see that most problems that were brought up two weeks ago have been solved and everything is clear as far as they are concerned. When my turn comes, I ask Stepanov how realistic the start-up of the next one-million-kW unit at the Zaporozhye AES this year is.

"The start-up is realistic if we get all equipment in April", he answers immediately.

The next participant, Manager of Smolensk AES Construction Administration B.Reva, has the same answer, word for word, to the same question. It is scheduled to commission there the third one-million-kW unit, and the list of equipment shortages is as impressive as at other AES. The third quarter results of work at the start-up unit are quite optimistic. If all equipment is received in April, the start-up will take place in December.

The Rostov AES, where the start-up of the first one-million-kW power generating unit is scheduled, is the last in the roll call. Apparently, because the situation there is the worst. There is no trace of optimism in the voice of A. Shiryayev, Chief Engineer of the Construction Administration. He began his report by telling about an accident at the construction site. A crane metal structure had broken off, because anchor bolts turned out to be defective. Fortunately, nobody was hurt, but 1,600 m of special cable had been lost. They are sending a plane to Krasnoyarsk to pick up the cable. Negligence in manufacturing of bolts which cost kopecks resulted in many thousand rubles of losses.

And how is one to measure the losses caused by voluntaristic planning? Start-up of the first unit at the Rostov AES was scheduled for the last year. But one had neither work force nor equipment to do that. And today the situation is the same.

It looks as if both the customer and the contractor are playing thestagnation time games: issuing orders, scheduling due dates and pronouncing slogans. But in doing so, they are pretending they do not see that neither can be done. Shiryayev gave an unambiguous answer to my question as to how realistic the start-up of the first one-million-kW unit at the Rostov AES is:

"Absolutely unrealistic. If equipment is delivered the same way as now and if Minyugstroy SSSR [USSR Ministry of Construction in the Southern Regions of the USSR] organizations keep ignoring our project, there will be no start-up even next year."

In the past, we had repeatedly seen how corrupting the effect of unreal plan targets was for collectives. Alas, even nowadays this practice has not been gotten rid of.

12770

Soviet Specialists Discuss Chernobyl, Future of Nuclear Power Industry

18610191e Moscow APN in Russian 22 Apr 88 pp 1-4

[Article by Yuri Kanin, APN scientific correspondent: "Soviet Specialists' View on the Nuclear Power Industry: Two Years after Chernobyl"]

[Text] A briefing for Soviet and foreign journalists with the participation of top executives of some energy Ministries and departments of the USSR and prominent scientists was held at the Novosti Press Agency on April 20. Its subject was "Problems of Safe Development of the Nuclear Power Industry with Due Account of the Lessons of Chernobyl and Other Accidents at the World's Nuclear Power Plants".

Chernobyl, the most ruinous accident in the history of the nuclear power industry which took 30 human lives and caused a loss of 8 billion roubles from the state budget, impelled the Soviet leadership to correct the earlier approved plans of the development of this industry. An inspection of all Soviet nuclear power plants was carried out, all their personnel underwent a course of retraining, the quality standards at plants manufacturing nuclear-power-generating equipment were raised, a special system of state acceptance of equipment for nuclear power plants was introduced. Protection measures have been made more stringent at all nuclear reactors. According to Deputy Minister of the Nuclear Power Industry of the USSR Alexander Lapshin, these measures now rule out even the very possibility of putting a reactor into a critical condition through its operators' errors. It was decided to stop producing RBMK reactors (of the Chernobyl type). For all that, the rate of the construction of nuclear power plants remains high. While their aggregate capacity was 28 million KW in 1985, it is to double by 1990 (the plans envisaged a figure of about 70 million kW) and to treble in another five years. But it will take a lot of effort to attain these figures. Illustrative of this is specifically the recent decision of

the Bureau of the USSR Council of Ministers for Fuel and Energy Tandem to stop building the Krasnodar nuclear power plant. The psychological wounds of the Chernobyl accident have not yet been healed, and the regaining of trust in the nuclear power industry among a part of the population requires more thorough designing and more profound substantiation of the choice of sites for plants, and is linked with public debates and permits by the local authorities.

"Neither we, nor other countries can do without the development of the nuclear power industry", Vice-Chairman of the Bureau of the USSR Council of Ministers for Fuel and Energy Tandem, Yuri Semenov, said. "Mankind has taken a logical road of the restructuring of the energy system. While today it is based on organic fuel, nuclear, thermonuclear resources, renewable sources of energy will form its basis in the future. It is certainly a long process, and its intensiveness will vary in different countries for many reasons, both objective and subjective. Though organic fuel will prevail in the world's energy balance till the middle of the next century or during an even longer period of time, such restructuring is inevitable. But it will not come on its own but must be carried out consistently because momemtum in the power industry is great and there can be no rapid changes in it. The plants which we are beginning to build today will give yield in the 21st century.

Since the briefing lasted nearly two hours, I will try to present the questions and answers in the form of short dialogue.

Question: What is the current situation in Chernobyl?

Answer by Alexander Protsenko, Chairman of the USSR State Committee for Atomic Energy: The plant's operating conditions are normal. Power-generating units No. 2 and No. 3 operate at the nominal capacity and unit No. 1 has been stopped for planned repairs. Over 98 per cent of the plant's premises have been put in a normal operating condition. The level of radiation on the territory of the plant is measured in hundredths of a milliroentgen which is by an order of magnitude smaller than the gamma background radiated by, say, a granite monument. Last year the average level of radiation exposure of the plant's personnel averaged 1.45 rems (the international norm is 5 rems a year).

Question: But the personnel works on the basis of a watch method, does it not?

Alexander Lapshin: For the time being it does. A watch team works for 12 hours daily for five days and then goes away to have a rest for a week. A new town of nuclear power workers, Slavutich, for 20,000-25,000 people is being built 50 km away from the plant. Its first section has been turned over for tenancy. The watch method will be abolished this October, and the personnel will switch to a 6-hour working day.

Question: And what will become of the town of Pripyat where the personnel of the plant lived before the accident? What is the situation there?

Answer: The town has been completely decontaminated. The radiation level of 3-4 milliroentgens an hour still persists in some parts of it but the radiation level on the greater part of its area does not exceed 0.03-0.04 milliroentgen an hour. About 500 people live there with the permission of the USSR Ministry of Public Health, working mainly in communal services and the urban economy. The radiation situation of Pripyat improves much more rapidly than it was expected. The hothouse laboratory operating there conducts experiments of great interest to science. The question of returning the inhabitants to the town is not raised for the time being, and their return is not planned for the immediate future.

Question: How does the encased reactor behave?

Academician Nikolai Ponomarev-Stepnoi, Deputy Director of the Kurchatov Institute of Atomic Energy: In accordance with the theoretical calculations, it becomes even more "drowsy". The reactor, glutted with sensors, serves as a unique research testing grounds. All specialists in the countries developing the nuclear power industry will be informed of the results of the research work, done there, through the IAEA.

Question: But it was reported that "volcanic" ejections from the "sarcophagus," and even explosions took place...

Answer: Such reports are evidence of the fabrications campaign which is still continued by some people and which has long been condemned. This campaign, conducted with the help of the "radio voices", does moral damage to the inhabitants of Kiev, the capital of the Ukraine, causing psychological tension among credulous people. Anyone who wants to learn the news from Chernobyl can ring up the Information and International Relations Department specially established at the plant. Its telephone number is 5-28-05.

Question: Were there any accidents at the other Soviet nuclear power plants after Chernobyl?

Yuri Semenov: Fails of some elements of equipment were registered but there were no accidents.

Other questions were also put, specifically on the medical theme which deserves a more detailed talk. We will return to it after the international conference "The Medical Consequences of the Chernobyl Accident" slated to be held in Kiev from May 11 to 13. I only want to say here that the two years of the special medical observation over the people who participated in the elimination of the consequences of the accident, over those who were evacuated from the 30-km zone, and

over the pregnant women and the new-born children do not confirm the validity of the frightful forecasts which were published by many press organs after the Chernobyl accident.

02291

Design of Electromagnetic Drive for Nuclear Reactor Control Rods

18610178b Moscow ENERGOMASHINOSTROYENIYE in Russian No 2, Mar-Apr 87 pp 25-28

[Article by Doctor of Technical Sciences V.V. Voskoboynikov, Candidate of Technical Sciences B.K. Klokov, and Engineers V.I. Tsukanov, S.N. Pushkin and A.F. Linyova]

[Abstract] A new trend in development of control rod drives is the use of linear step motors with a longitudinal magnetic flux. A design for the magnetic system of such motors is proposed. Based on the proposed method for calculating the electromagnetic force, a PSTAT1 program in the FORTRAN language was written for the YeS computer series. A block diagram of the problem is presented. Using the program, several variants of control rod drives were calculated. Results of calculations were compared to experimental data: for unsaturated magnetic systems the difference was negligible. The proposed method for calculating static characteristics will be particularly useful for design of electromagnetic drives in plants with high-temperature gas-cooled nuclear reactors. Figures 7, references: 5 Russian.

12770

Large Gantry Crane Used at AES Construction

18610006 Moscow STROITELNAYA GAZETA in Russian 27 Sep 87 p 1

[Article by O. Dudko, director of the Volgoenergomontazh Combine, Kuybyshev: "Conveyer for AES"]

[Text] **A domestic 400-ton load capacity travelling gantry crane made it possible to develop a construction-assembly conveyer at the Balakovo AES construction site. Assemblers, competing for a suitable way to meet the 70th anniversary of the Great October Revolution, with the help of this organizational and technical novelty have tripled the level of industrialization and reduced labor input by 100 thousand man-days.**

The 400-ton lifting capacity giant travelling-gantry crane at the Balakovo nuclear power plant now under construction gives it its own distinctive appearance. However, the point here is not the "exotic" aspects of construction. With the appearance of this crane it was possible to organize a real construction assembly conveyor. The preliminary assembly of three-dimensional units from structural elements and process equipment with the total weight of up to 300-350 tons is carried out on special platforms.

The crane is of domestic manufacture and was built in Zaporozhye. It is true that it was somewhat late in delivery, and that the equipment of the No 1 power unit was assembled mainly without its help. However, the use of this crane even at the last stage of construction of the No 1 unit allowed the builders to reduce the labor input by 16,000 man-days. During the construction of the No 2 unit, there was an opportunity to organize the preliminary assembly of pipelines and equipment in specially built shops. The level of the assembly work industrialization compared with that of the No 1 unit had tripled, and the labor input decreased by 100,000 man-days.

Still, we together with the general contractor Saratovgesstroy and other related organizations could not start-up both the No 1 and No 2 units on time. Work is lagging also at the No 3 unit. Many times we analyzed at the combine our own mistakes and those of the related organizations, because there will be start-ups of two more "millionnik" units at the Balakovo AES and four units of the first stage of the Tatar AES. Assembly of AES heat power equipment is a new work experience for the collective. Though we had prepared ourselves quite carefully for the task, the problems happened to be much more complicated than we had expected.

Construction of an AES also requires fundamentally new production management. Presently, the general contractors do not care much for the equipment assembly specifics. Again and again they disrupt the specified schedules, thus forcing us to do crash work. During construction of a TETs we still can assign a large number of assemblers. It is completely different at nuclear power plant sites: crash work cannot be allowed here.

The AES technology using the 400-ton gantry crane allows the assemblers to carry out floor-by-floor large-unit assembly of building structures, pipelines, and heat power equipment of reactor units. In the final analysis, this was what had the largest effect. However, this technology is idling in the meantime due to systematic disruptions in equipment and pipelines supply. Thus, for the No 3 power unit, only 18 of the required 120 piping systems were received on time and were complete. Now, the floor-by-floor box units assembly of the reactor building of the No 4 power unit is being started. However, there is still no equipment supply schedule available.

Nevertheless, the new technology has already been tried to a degree that one may, without fear of contradiction, predict that it is the future of high-speed construction of standard AES. However, there are still opponents of this technology at Minenergo SSSR [USSR Ministry of Power and Electrification] who have made their stake

not on the 400-ton domestic gantry cranes, but rather on imported jib cranes of smaller lifting capacity. And in spite of those who are building the Tatar AES, the technical council of Minenergo decided to build it using an imported 250-ton crane as the main lifting mechanism.

I don't understand it: couldn't they find a better place to spend hard currency? It would be much better if they would spend it on technical refitting of the combine. The point of view of the Volga-Kama builders of nuclear stations is to order immediately a 400-ton gantry crane for the Tatar AES. Without it, the start-up of the No 1 power unit may not take place at the scheduled time.

13355

Zaporozhye AES Reactor Shell Discussed

18610007 Moscow STROITELNAYA GAZETA in Russian 3 Sep 87 p 2

[Article by N. Spiridonova under the rubric: "Awarded USSR Council Of Ministers Prize:" "The Atom in a Trap"]

[Text] **The vibrator sound increased steadily as if it were raising itself up step by step. The vibrator's power was being applied to a three story frame (two vertical walls and three floors) causing in it a "nervous" tremor penetrating into the foundation. Two vans looking like ambulances were parked near the frame. Multiple wires connected to sensors were running from the vans to the "half-finished" building. The load was increasing and the frame vibration amplitude was doing the same. It seemed that any time now the frame would start swaying from side to side and "shifting" from one wall to another. Suddenly, it became quiet. A minute of rest, and again the powerful sound penetrates the air: the frame has started to shake and sway in the opposite direction.**

Someone standing at a distance among a group of observers said with annoyance: "We should build a box structure. Without a second set of walls the structure may collapse at such load ...". Another man asked: "Why did they climb on this 'bookstand' themselves? Recalling the ancient times maybe, when designers had to stand under a new bridge, answering with their heads, so to speak, for its safety?"

As to the people working on the floors of the vibrating structure—engineers from Atomenergoproyekt and their scientific colleagues from Orgenergostroy—they were sure of the reliability of the design. In spite of apprehensions, the frame representing a full-scale section of the Zaporozhye nuclear power station easily withstood a 9-point "earthquake".

The probability of a 7-point earthquake in the region of Zaporozhye is insignificantly small: one in 10,000 years. And it's not often that the flammable cargoes of barges or freight train tank cars will explode. However, everything must be foreseen. The AES building must withstand powerful seismic loads, exterior shock waves, hurricanes, and tornadoes. Nothing should disturb the heart of the station, which is the nuclear reactor, and nothing should affect its normal operation.

... Calculations, tests. New calculations and new tests. They were bending, breaking, burning, exposing to radiation, tearing apart, compressing, and exposing to hot steam mock-ups, individual structures, and full-scale fragments. Month after month, they searched for the necessary strength, density, hermeticity, impermeability to gases, exact shapes and sizes, and new principles of assembly and construction. They developed new machines and devices, specifications for the plant, high-precision concrete molds, and many other things.

Designers of Atomenergoproyekt Minatomenergo SSSR [USSR Ministry of Nuclear Power Engineering] in Moscow, Kharkov, and Gorkiy; scientists of Orgenergostroy Minenergo SSSR [USSR Ministry of Power and Electrification]; engineers of the Donetsk branch of the All-Union Institute for Planning Construction of Nuclear Power Plants of Minenergo SSSR; and specialists of the All-Union Construction and Assembly Association Soyuzatomenergostroy of Minenrgo SSSR worked in close creative contact. They designed a set of industrially-assembled one- piece [prefabricated] structures for construction of a series of standard AES with VVER-1000 power units (1000 MW water-cooled water- moderated power reactors). Now, this work has received the USSR Council of Ministers' Prize for 1987.

In looking over the tersely-worded results of this work, I had noticed that many of the technical solutions are recognized as inventions. The total economic impact of their implementation amounted to more than 4 million rubles. Those one-piece pre-assembled unit-cell walls (Certificate of Authorship No. 1017046) are among the inventions.

Completed structures, ready-made in a plant with the specified facings and parts for shoring up all openings and passages are shipped to the construction site. In all structures the load-bearing planes also act as non-removable formwork, which simplifies and speeds up construction and assembly work. Even the assembly of compartments with a very complex wall configuration is carried out, like assembly of automobiles, using ready-made parts. This precision and apparent simplicity were preceded by a tremendous amount of work in standardizing all structures.

At the Zaporozhye AES, which is the leading pilot-project construction site for a series of nuclear power plants being built using a standard design, the prefabrication of structures practically reached 100 percent. As a result, working conditions and efficiency were improved, and labor productivity doubled. It took 8 years to build the most labor- intensive No 1 power units at the South Ukraine and Kalinin AES and 4.5 years to do the same at

the Zaporozhye AES. Introduction of the industrial flow line high-speed construction method allowed the builders of the Zaporozhye AES to build each suceeding power unit (after the No 1 unit) in one-year intervals.

An involuntary thought had entered my mind: would not such acceleration lead to a ... a new Chernobyl? This question was answered by Honored Builder of the RSFSR, chief specialist of the Department of AES Design Supervision at Gosatomenergonadzor SSSR, B. Kobyakov: "Owing to these industrially-assembled structures, the new AES are being built without haste, at a normal pace. In general, the safety of a nuclear power plant is established at the design stage. The present standard design has a different principle of building arrangement. The old plants had two reactors in one main building. Today, only one reactor is housed in each unit. Experience had shown that this arrangement is more reliable. In addition, the design specifies a heavy reinforced concrete containment vessel designed to withstand full pressure. This vessel hermetically encloses both the reactor itself and the reactor room as a whole. Our inspection keeps an especially watchful eye on its construction. Reliability and construction quality are satisfied by the Gosatomenergonadzor requirements."

This vessel can withstand the so-called maximum design accident, in which a reactor cooling loop pipe ruptures, the temperature goes up to 150 deg.C, water boils instantly , and the generated steam contaminated by radioactive elements applies an overpressure of 4-5 kg/sq.cm to the vessel. Therefore, this vessel is called a full-pressure vessel.

It is a cast reinforced-concrete cylinder 45m in diameter and 54m high covered with a sloping spherical dome.

Prestressing of the containment vessel is carried out using a completely new approach. Each of the reinforcing cables forms a giant loop consisting of a bundle of high-strength steel wires. The cylinder loop length is 179m and dome loop length is 80-90m.

Each loop is pulled through a channel or conduit (polyethylene pipes) and, after going all the way around the cylinder (dome), comes back to the cornice at almost the same point from which it started. Here, hydraulic jacks (Certificate of Authorship No. 600084) grip both ends of the cable loop and stress it with a 1000-ton load. The containment vessel prestressed by this method is within a very strong three-layered three-dimensional grid.

The chief engineer of Atomenergoproyekt, candidate of technical sciences V. Tatarnikov, who himself did not directly participate in this work but who knows its contents, evaluated the results in the following words:

"The integrated use of industrially-assembled one-piece structures raises our power engineering to a new, higher level. The full-pressure containment vessel was accepted for the standard design as the simplest in a technical sense. It is related to the so-called nonmaintainable vessels, because it is opened only during scheduled repairs and refueling. The rest of the time it is hermetically closed off, and the reactor controlled by automatic systems is reliably sealed."

In addition, these structures may be used for construction of AES having different arrangements and containment vessels, and for construction of industrial installations unrelated to nuclear power, since their concepts are sufficiently universal.

13355

Future Civilian Job of Missile-Transporter Vehicles

18610434 Moscow DAILY REVIEW: TRANSLATIONS FROM THE SOVIET PRESS (APN) in English 6 May 88 pp 1-3

[Article by Igor Rozov, correspondent for Vechernaya Odessa, under the rubric Around the Soviet Union]

[Text] It would not be an exaggeration to say that all sober-minded people on this planet hope that the Soviet-American Treaty on the Elimination of Intermediate- and Shorter-Range Missiles will be ratified. The work force of the Odessa High-Duty Crane Building Amalgamation is no exception in that sense. However, in addition to the commonly shared interest, people who work there have special reasons to look forward to the ratification—a major project that holds out a promise of a neat profit for the Amalgamation, one of Odessa's largest manufacturers, depends on the outcome of the ratification process.

Nikolai Andrienko heads the State Development Centre that designed many high-duty cranes which made a fairly good showing in the national economy. Several years ago the Odessa Amalgamation established business contacts with Poland's Bumar, also a crane manufacturer, and last year it found another business partner—West Germany's Libherr.

"It was during Mikhail Gorbachev's visit to the United States that we got the idea of using SS-20 missile transporter vehicles as a chassis for a giant mobile crane with a high cross-country capacity," Nikolai Andrienko told this correspondent. "Such cranes could be used for a variety of civilian jobs, notably the construction of bridges and industrial buildings. Our designers had only a short time to come up with the concept design. We had only several weeks because many other manufacturers needed high-duty transporter vehicles badly."

True, ministries and departments literally bombarded centralised planning agencies with requests. For instance, geologists and oil workers wanted the missile-transporter vehicle chassis for mobile drilling rigs. In

such conditions preference was given to those who were the first to come with feasible designs and the necessary production forms and documents.

"We were among the first," Nikolai Andrienko said proudly. "So, the first lot of several dozen chassis is to be made available to us."

How will they be used? The Odessa Amalgamation is currently working on three high-duty crane designs. Two of them are meant for the foreign partners of the Odessa manufacturer. Bumar, its many-year partner, is in fact ready to build the first sample of the machine. Its turning platform and boom developed jointly by Soviet and Polish designers are undergoing tests.

Only a few weeks ago Libherr's representative visited the Odessa Amalgamation. It should be noted that the West German company has been doing business with Soviet foreign trade agencies since 1972 and has delivered cranes to the sum of $400 million to the Soviet Union since then. It was the supplier of 333 specialised cranes used in the early 1980s during the construction of the trans-Siberian pipeline (these are robust machines that can operate at temperatures right down to 58 degrees Fahrenheit). During the recent visit Libherr's representative discussed prospects for cooperation with the Odessa crane manufacturer. Special attention was devoted to plans for the production of a new crane to be based on the missile-transporter vehicle chassis. The partners examined drawings prepared by Odessa designers.

"It is planned to build machines with a weight-lifting capacity ranging from 80 to 120 tons and telescopic booms up to 70 metres long," Andrienko explained. "There is a high demand for such cranes. We are very pleased with the transporter vehicle—it has a high cross-country capacity and is quite economical. We believe that the designers have already done their part of the job and now it's up to production engineers and workers to have their say."

But Gennady Panyushkin, Chief Engineer of the Odessa High-Duty Crane Building Amalgamation, sounded somewhat annoyed. In his opinion, many Moscow-based and local newspapers came up too early with reports about the planned production of cranes on the basis of SS-20 missile-transporter vehicle chassis.

"The Treaty has not been ratified so far, and it's still too early to speak about the mass-production of new cranes," Panyushkin stressed. "We're looking forward to the final decisions of the U.S. Senate and the USSR Supreme Soviet on the Treaty. That will make it possible to get down to business. Let me tell you that Libherr is also waiting for the ratification process to be completed."

"But then," Panyushkin smiled, "you understand that business considerations are not the only thing that makes us so impatient. All of us would like the Treaty to be ratified and the sooner the better."

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Structural and Organzational Prospects for Development of Production Potential of Machine Building Industry

18610022 Moscow VESTNIK MASHINOSTROYENIYA in Russian No 9, Sep 87 pp 67-69

[Article by Candidate of Economic Sciences O.A. Zverev under the "Organization and Economics of Production" rubric]

[Text] During the years 1960-1985, fixed production assets in the national economy of the USSR have increased seven-fold and exceeded 1.5 trillion R, which is equal to 44 percent of the nation's wealth. Along with the quantitative growth must come qualitative renovation of production facilities as well, mainly through rapid replacement of low-efficiency equipment with progressive and highly productive machines.

The machine building industry makes the principal contribution to the formation of the active portion of production potential. The solution of one of the main social problems, the reduction of the share of manual labor, especially in the ancillary production and service industries, depends to a large degree on the level of development of the machine building industry.

The current stage of scientific and technical progress puts in a new prospective the problem of forming the technical, structural and organzational basis of the machine building industry. This is due, first of all, to the need to create resource-saving equipment, and second of all, to a sharp increase in the product mix and the number of types and sizes of manufactured equipment, which can only be done based on division of labor and the development of part and process specialization.

For a long time, development was based on a physical increase of the production potential, and the improvement of the structure policy was hampered due to a number of reasons.

One of the reasons is that in times of extensive growth of production potential there is no incentive for making qualitative changes in its structure. Otherwise, improvements in production structure are inevitably accompanied by a decrease in physical production volume, especially at interim stages, where traditional types of raw and production materials are being replaced. Thus, for instance, replacement of sheet metal fuel tanks in motor vehicles with high-density polyethylene results in three-fold savings of metal. In addition, capital expenditures per ton of chemical materials are 4251 R less, and labor consumption decreases by 118 man-hours. If one takes into consideration that the above numbers affect the interests of several industries, and the scope of their production and business activity is reduced due to the changes, one can understand why progressive structural materials are being implemented so slowly.

The national economy as a whole and each individual enterprise have the same goal, as far as efficiency improvement: to increase the efficiency of installed equipment. But as far as the end results are concerned, there are contradictions between the national economy and cost accounting [khozraschet] interests, and these contradictions are aggravated by the imperfect system of evaluation indices. Whereas the society is mainly interested in increasing the end result of utilization of means of production, the goal of an enterprise is to pursue an equipment policy that does not permit a decrease in the production volume of its established output.

This contradiction inevitably results in trying to get more money for equipment repair rather than replacement, and in deceleration of the pace of renewal of fixed assets at industrial enterprises. Quite often, CNC and robotized machine tools work side by side with machine tools 30 to 40 years old that are morally obsolete and require large expenditures for repairs. This also increases the number of models in the equipment fleet, hence considerably increases maintenance costs.

On the average, the annual retirement of morally and physically obsolete equipment in 1980-1985 did not exceed 1.3-2 percent. Because of this, the difference between the commissioning and retirement of fixed production assets was increasing, which can be seen from the following data [1]:

Years	1971-1975	1975-1980	1980-1985
Commissioned, percent of cost of assets, at the end of the period	46	42	37
Retired, percent of the total cost of assets, at the beginning of the period	11	8	4.5
Commissioning-to-retirement ratio	4.5	5.2	8

In some industries, equipment age structure is changing toward aging. Thus, in the electrical equipment industry 41.5 percent of all machine tools have been in operation for over 10 years, including 10.9 percent for over 20 years.

The change in equipment age structure toward obsolete models has led in recent years to lower capital productivity and profitability of fixed assets in the machine building industry (from 16.6 percent in 1975 to 12.2 percent in 1984). A low level of specialization has significantly contributed to the decrease in equipment utlization indices. Analysis conducted by the Economics

Institute of the USSR Academy of Sciences in 29 subindustries of the machine building industry has demonstrated that at specialized plants, levels of labor and capital productivity are 20 and 25 percent higher, respectively, than at plants in their customer industries.

The desire to maintain or slightly increase the production volume of the established product mix called for ever increasing expenditures for reconditioning of fixed assets, rather than for its expanded reproduction. This was preventing redistribution of resources and allocations toward improving the structure of production potential and, accordingly, to the development of specialized production facilities. At the same time, qualitative structural perestroyka of fixed assets through accelerated renewal (at an annual level of 4 to 6 percent) would have reduced capital expenditures by a factor of 1.5-2, compared to expenditures from the amortization fund for reconditioning and modernization. [Footnote 1: according to calculations by Ye. Pavlova, PRAVDA 12 Nov 1984, this would total 7 percent of industrial investment and 1.9 percent of machine building industry output.]

In the late 1970s-early 1980s, deep changes related to the implementation of innovative types of equipment and technological processes began in the machine building industry. The relative proportion of equipment for multi-industrial application, such as instrumentation, plant transportation equipment and computers, keeps growing. But if this technology develops according to the existing forms of specialization, in the machine building industry it will result in a hypertrophic increase in production of semi-finished products such as blanks, subassemblies, parts and fixtures. Even now, the share of multi-industrial application products is over 25 percent.

Under closed-loop production conditions, when all ancillary and service processes are performed within the same enterprise, a considerable mismatch of production capacity occurs. Under these conditions, the implementation of innovative technology is hampered, because when implemented in just one link of a multistage production process it immediately introduces disbalance into the enterprise as a whole. At the same time, the innovative technology is not being used to its full capacity. For instance, high-quality lathes or CNC machine tools are often only 15-20 percent utilized.

The low level of part specialization is holding back the development of item specialization. One can see here a direct relation: the number of assembly departments and plants can grow, provided the supply of semi-finished products and subassemblies increases, but a closed-loop production cannot do this. In some cases, enterprises are forced to develop in-house production of certain types of scarce products. One can this happening in the case of general-use machine building. Thus, 22 plants of the Ministry of Heavy and Transport Machine Building manufacture only 17 percent of machines for underground transportation, whereas the remaining 83 percent are manufactured at 400 plants of 33 Ministries.

In 1986-1990, it is planned to accelerate the renewal of fixed assets, first of all by rapid replacement of inefficient equipment with progressive high-throughput machines. More than 50 percent of the active portion of fixed production assets will be renewed, and the scope of renewal of obsolete assets will increase at least threefold. The policy of renewal of fixed assets must be based on the transition from replacing individual machines and equipment to integrated systems of machines and technological processes that cover entire modules of functional subsystems, both in main and ancillary production. In machine complexes, the capability to combine universal and specialized equipment is much higher. This is due to the fact that systems of machines lead to the transition from mixed to part machining specialization based on unified subassemblies.

An optimum combination of all forms of specialization makes it possible for enterprises that specialize in manufacturing end products to focus their attention on problems of organization of scientific and technical preparation of production and rationalization of assembly processes, study the market demand in greater detail and expand the scope of machine service.

As progressive forms of specialization develop, such as part, subassembly and process specialization, another form will be developing too: modular specialization, based on unitizing and modular construction of technical systems. Once again, this proves V.I. Lenin's conclusion that specialization of public labor "... is by its very nature infinite—just like the development of technology" [2].

Modular specialization objectively reflects production's desire to come as close as possible to meeting individual consumer demands, while constantly increasing the number of makes and models of products of the machine building industry. Complete individual modules can be combined to form machines and mechanisms for various functional applications. In essence, unified technical modules will form the foundation for an array of machines for multi-industrial application.

So far, one can only see a general outline of modular specialization in the machine building industry. Thus, within the framework of the Integrated Program of Scientific and Techncial Progress of CEMA Member Nations up to the Year 2000, the Moscow ENIMS [Experimental Scientific Research Institute of Metal-Cutting Machine Tools] NPO [scientific production association] has started the development of a unified technical policy in the area of metal-cutting equipment, based on broad standardization and unification. The use of Bulgarian circular grinders for creating of flexible

manufacturing systems is but one example of the implementation of such policy. Another example is manufacturing of transfer machine tools, mastered at the Moscow Machine Building Plant imeni S. Ordzhonikidze.

Modular specialization can increase not only due to broadening of functions of machines and transfer mechanisms, but also due to new modules that perform control functions. The main elements of control modules are electronic circuits that can be used in equipment and instruments for various production applications.

However, the high efficiency of modular specialization can only be based on broad utilization of unified assemblies. One of the main production contradictions is between the producer's interest to increase the volume of serial production and the need to be ever more guided by the constantly changing demand and technical and economical requirements on machines and equipment. It has been proven statistically that the higher the level of serial production, the higher is the level of specialization, with the highest level in mass production. However, another problem arises here: that of providing rapid equipment set-up. At present, about 60 percent of automatic and mechanized continuous production lines in mass production produce a single part.

Enterprises with limited and medium-series production are less specialized (the share of side-line products exceeds 30 percent). These enterprises manufacture 75-80 percent of all metal fabrication products, and they have a constantly fluctuating product mix. Only a few of these enterprises are oriented toward manufacturing unified products that can be used not only for a certain type of machines, but also for a wide equipment spectrum. This forces one to increase, as necessary, the number of models and types and sizes of products of the machine building industry and reduces the level of mass-production in manufacturing subassemblies, parts and units.

In the immediate future, each subindustry in the machine building industry must convert to manufacturing parametric series of machines, using unified subassemblies and parts based on a few base models. Mother Nature itself gives us an example: using a few basic elements, it has created the huge variety of forms of organic and inorganic matter. In this respect, of interest is the experience of the Moscow machine tool building production association Krasnyy Proletariy in developing a family of machine tools for various types of production and application conditions. The family includes over 40 modifications, and each modification uses from 426 to 460 parts from the base model. As a result, the level of unification is equal to 90 percent.

Modular specialization based on the optimum technological and part specialization makes it possible for enterprises to offer an optimum selection of machines and equipment. By combining individual technical and production components into systems supplemented with integrated service, one can create bays of highly efficient production facilities of the new type characterized by a low capital content.

Having a versatile assortment of modular design machine tools with numerous serial-production components, one can come close to implementation of the principles of flexible automation. Flexible manufacturing systems have the following main advantages: a sharp reduction of the production cycle length, increased assortment of manufactured end products, higher equipment throughput capacity, lower personnel expenses, reduced production preparation time when changing the types of manufactured products and reduced requirements for equipment and storage areas. Flexible manufacturing systems can include machining centers, CNC machine tools, robots, automated material handling systems for bringing materials and parts to the machine tools, automated production control systems and microcomputers. It is anticipated that the implementation of flexible manufacturing systems will result in a three- to fourfold increase in labor productivity and in improved product quality.

The development of the new technical basis of the machine building industry calls for improvement in the level of production organization and management. The negative experience of many enterprises that are implementing CNC machine tools but have not changed obsolete organizational forms of their production process has vividly shown possible losses to the national economy. Really revolutionary technology often calls for radical solutions not only in the area of organization of technological preparation, but also in the areas of material and equipment supply, payroll and labor incentives; it even calls for new architectural and layout solutions in the design and reconstruction of production shops. It also calls for integrated solutions to problems of specialization in the development, manufacturing and implementation of progressive types of equipment and flexible manufacturing processes, as well as providing necessary tooling and fixtures. Only then would it be possible to solve the key problems of bringing the machine building industry to the forefront of science and technology.

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12770

Party Efforts in Machine Tool Industry, Reconstruction

18610026 Moscow SOVETSKAYA ROSSIYA in Russian 13 Oct 87 p 2

[Article by G. Podlesskikh under the subhead "Reconstruction: Running in Place or What is Holding Back Output of Progressive Equipment"]

[Text] Products of the Moscow Machine Tool Building Plant association are in great demand. The grinders manufactured here are needed for hundreds of enterprises which use them during finishing process operations in order to increase the quality of their products. The demand for grinders especially increased after the introduction of State Acceptance. While the association has a backlog of orders for many years to come, it can satisfy only about half of the national economy's demand for MSZ [Moscow Machine Building Plant] brand grinders. The Main Plan-Economic Administration of Minstankoprom [Ministry of the Machine Tool and Tool Building Industry] had set a plan for the association to manufacture during the next year more machine tools than specified by the five-year plan control figures. The main administration based its decision to increase the plan on the needs of the machine building complex rather than on the technical capabilities of the veteran plant which is more than 100 years old. The shop buildings are dilapidated. Up to 70 percent of all buildings were constructed more than 50 years ago.

Reconstruction of the enterprise became a necessity long ago. Authoritative bodies have made this decision three times already. What has been done? To tell the truth, not much. And today there is no place in the existing production areas to install progressive equipment. Therefore, less than 25 percent of the total number of machine tools at the plant are the high-capacity machine tools. People also suffer. A substantial part of the shops do not have everyday accomodations. And this takes place not in some provincial town, but at an enterprise in the capital where people work with micron accuracies and manufacture modern high-capacity machine tools. Indeed, how can one talk about perestroyka, about acceleration, when quite often there is no place to wash up after work? And should one be surprised that with this attitude toward people, there is a great shortage of cadres at the association.

Representatives of the ministry sometimes reproach the MSZ collective: "They want us to build facilities for them based on government decisions! And what about doing it themselves? Where are their own in- house resources [khozsposob]?"

It would'nt hurt one of these critics to come to the plant late some night. Then he would see for himself that the machine builders work under floodlights, and work on Saturdays and Sundays. Were it not for the enterprise's own resources, the workers of the transport shop would repair equipment this winter again outside in the cold. This year they will get a warm, convenient building.

However, the construction section cannot do everything. Specialized labor like framing is outside their field of competence. There is an acute shortage of more than just certain everyday items. Engineering and design services, for example, are located in a former warehouse unsuitable for normal work. The window frames rattle with every gust of wind.

Lately, the issue of reconstruction has become especially acute. In November, representatives of the West German machine tool building firm Wendt will come to Moscow in order to sign a legal contract with the Moscow Machine Tool Building Plant association's management to form a joint venture. Efficiency calculations have been already made and all necessary approvals from USSR Gosplan and the Ministry of Finance obtained. The bylaws, funds, and each partner's share have been discussed; a marketing program with a positive hard currency balance for our country was developed. It is specified that for the first two years the joint venture will lease a part of association's production areas and after that it will be located in the Annex, as the new shop is called in the reconstruction plan. However, the problem is that this annex is not going to be built. At least not within the specified time. Thus, the Moscow Machine Tool Building Plant is in breach of contract...

What does this joint venture mean for us? Today, the association produces annually around 50 machine tools for grinding hard-alloy plates and it buys certain components from Wendt. Our country also buys approximately the same number of similar grinders abroad spending large sums in freely exchangeable hard currency. When the joint venture is created, the demand of national economy for these machines will be completely satisfied. In addition, hard currency deposits will start flowing into our commercial accounts.

Who determines, in the first place, whether reconstruction will take place and what its schedule will be? Of course, it is the headquarters of the branch, and in particular, Deputy Minister A. Vasilyev. However, Minstankoprom has not specified at all the reconstruction of the association during this five-year plan. By the way, the same is true for many other Moscow enterprises of the ministry. However, the CPSU Moscow City Committee, concerned that machine tool building in the capital is getting too little attention, disagreed with this approach. As a result, a protocol for coordinating the volume of construction- assembly work performed in 1988-1990 by Glavmospromstroy [Main Moscow Industrial Construction Administration] as subcontractor was signed by the gorplan [city planning authority] chairman, Ye. Bystrov and Deputy Minister A. Vasilyev. This document also does not include the Moscow Machine Tool Building Plant association. In May a meeting of the Minstankoprom staff took place. Its agenda was to discuss the next

year's plan. The Director of the Main Technical Authority V. Yefimov and the Director of the Main Administration for Design and Major Construction at the Branch Headquarters V. Sutyagin, among others, reported without a hitch. However, the general director of the association, A. Mandrovskiy, did not hear a single word with regard to construction of his enterprise in spite of all his efforts to not miss a thing.

And why did he hope to hear something?

"Well, and why shouldn't I?" answers Aleksey Vasilyevich, trying hard to control his agitation, "Deputy Minister Vasilyev has told me repeatedly that he has a firm agreement with the chairman of the gorplan to carry out reconstruction of the association in 1988-1990. We placed all our hopes on this agreement!"

The fact is that in an appendix to the Mossovet [Moscow City Soviet] decision, the Moscow Machine Tool Building Plant and the reconstruction schedule itself were mentioned. In order for this statement to enter the protocol, the branch headquarters had to agree that it was necessary. And they did not do it. However, the most surprising thing is that A. Vasilyev continued to assure the association's management of the existence of an agreement with the gorplan. He assured them even before the May staff meeting...

The Manager of the association's Division of Major Construction Yu. Gorbachev remembers: "We were so glad to learn that the Mossovet's decision specifying reconstruction of our plant, too, had been approved by the party gorkom."

Recently, many meetings and sessions of all kinds concerning the reconstruction of the Moscow Machine Tool Building Plant association have taken place in different departments. There were promises, assignments were given, decisions were made, and so much paper was used...

Few detective stories, I think, may compare in regard to the tension and red-hot passions with which events unfolded, in spite of their seeming routine and ordinary nature. Stories can be told about the general director trying to catch the gorplan chairman on the phone from the office of the deputy minister, about the manager of the association's major construction division checking from his office on the movements of the deputy minister; about the deputy director of Glavstankoprom, who was ready on a moment's notice to make a run with documents to the Mosgorplan [Moscow gorplan] and how he did make a run there, and how he spent several agonizing hours there in fruitless anticipation, and how he miraculously broke through into the office on the next day... But Yevgeniy Ivanovich Bystrov did not sign the papers. He made him understand that there was no agreement at all... Today, it is not important anymore who fooled whom. One thing is clear: the beginning of reconstruction of the association in this five-year plan period is very questionable. This is obvious to any production specialist who learned from this bitter experience that in order to demolish the old structures and to begin construction in 1990, the project must already be underway. However, there is no such project in the thematic plan of Giprostanok [State Institute for Machine Tool Building Plant Design].

And one should not forget that we are discussing machine tools, the shortage of which under state acceptance and full-cost accounting [khozraschet] conditions will cost hundreds of machine building plants dearly. Or will we be forced again to spend large sums of hard currency for foreign supplies? However, on the other hand, one does not pay out of his own pocket.

A responsible approach is required. Meanwhile, one thing is being written down in the decisions, another is being discussed, and it seems, they are going to do something else.

13355

Drums or Alarm Bells: Direction of Party Committee Efforts in the Machine Building Complex

18610026 Moscow SOVETSKAYA ROSSIYA in Russian 15 Oct 87 p 2

[Article by Ye. Chebalin and V. Shilov]

[Text] **In mid-September in the CPSU Central Committee a meeting took place, where an extraordinary situation in machine building was discussed. A production drop that was allowed to occur in the beginning of the year holds back the technological retooling of the entire industry.**

Together with the central departments and ministries, the responsibility for the situation in the machine building industry is laid on the local Party committees. They are called on to increase organizing activities in mobilizing machine builders collectives for shock work and use of all production reserves and capacities. How is this directive of the CPSU Central Committee being carried out in Kuybyshev oblast?

At the end of last year, when the labor collectives were formulating their socialist pledges in honor of the 70th anniversary of the October Revolution, several Kuybyshev enterprises came up with an important initiative. They announced their intent to fully meet their contract obligations for equipment supplies. This initiative was approved at the Party obkom buro and was widely covered by the local press. But as weeks and months passed this very important initiative was remembered less and less frequently. Similarly, in discussions with us the question of making up the backlog in machine building products supplies somehow was pushed aside into the shadows, into the background.

The Deputy Department Director at the Kuybyshev Party Obkom Sergey Sergeyevich Dubenko, the long-time curator of machine building, gave us the following arithmetic: "Since the beginning of the year, the machine builders of the oblast have realized almost 100 million rubles in above- plan production. The amount of debt in supplies is 30 million rubles. Total: positive balance of over 70 million rubles".

The Obkom Secretary in charge of industries Ivan Alekseyevich Abramov is no less optimistic: "As a result of strenuous efforts, we managed to overcome a large backlog which the machine builders allowed to build up in January-February. In terms of commodities output, the growth rate for the oblast machine building complex reached the planned level".

We got the feeling that the Party curators of the Kuybyshev industry to a great extent are satisfied with the fact that oblast machine building is not really all that "sick" when you look at its "average fever". At the same time, many complaints were expressed concerning Gosplan mistakes, Gossnab deficiencies, slowness of ministries, complications caused by the state acceptance, transportation problems, and unpaid bills for the shipped products. Thus, the success looked even better, since it was achieved in spite of all outside objective and subjective obstacles.

The averaged statistical data hide an insidious quality for levelling out bumps and ravines, and to create dangerous delusions. Sometimes it happens like that: the situation requires the alarm bells, while the responsible authority figures are in the mood for drums. If one dispels the illusion of averaged values, a rather bleak picture is revealed. Just deduct from the machine building "gross" 100 million rubles from the Volga automobile plant [VAZ] that are over and above the plan, and those pluses would change to minuses. Behind the powerful back of the VAZ one may find dozens of enterprises chronically ill with lagging. More than 70 percent of machine building plants breach their contractual obligations, slowing down the work of hundreds of customers and complicating the situation in many branches of national economy. However, the local bureaucrats feel more comfortable with their own arithmetic.

Deputy Department Director Sergey Sergeyevich Dubenko was energetically persuading us that of the total oblast production debt to customers of 230 million rubles, the machine builders owe only 30 million rubles, which is not too much.

Indeed, the 30 million rubles compared with the total volume of Kuybyshev oblast production does not weigh too much and at the All-Union scale this debt is negligible. However, again it depends on how one calculates it. For example, at VAZ they remember cases when because of penny-worth rubber parts shortages, delivery of hundreds and sometime thousands of cars was delayed. Economic losses to the State were in many thousands of rubles. Calculating from the point of view of the interests of the national economy, the losses from the Kuybyshev machine builders debt of 30 million rubles should be multiplied by hundreds of times at the All- Union scale. Delivery shortages of medium and large size bearings mean hampering production of tractors, trucks, rolling mills, and unique boring and turning machines. A cable plant is holding back development of long distance communication lines. Turbine builders have stopped equipment installation at the Irkutsk TETs-9, the Arkhangelsk Hydrolysis Plant, the Avdeyevka Coke and Coke By-Products Plant, and many ore-preparation plants, coal pits and mines. Over 20,000 TV sets have not been delivered to stores, which creates a multimillion ruble hole in the State commodities turnover. The chain reaction of delivery shortages quite often causes economic losses to increase in a geometric progression. Actually, it is happening already outside the boundaries of Kuybyshev oblast.

We anticipate the objections of local comrades: "What are these hints for? The general good of the state is not something foreign to us." Let us not argue, but pay attention to this fact. During a two- month period the above-plan production volume doubled (mainly due to the VAZ). This sharply improved the statistical accounting of the oblast machine building as a whole. At the same time, the delivery backlog did not decrease. It follows that the oblast growth rate data were improved, and as to the interests of the national economy, nobody cared too much for them. At the same time, many enterprises in today's complicated situation do manage to observe contractual discipline. There are also such enterprises among machine building plants and associations: the Volga Automobile Plant, machine tool building plant, Volgotsementmash [Volga Cement Machinery Plant], electric equipment repair plant, and a number of other plants. Why is it that some plants deliver on time, while others cannot manage it? This is the problem which the oblast and city Party committees should analyze. However, it seems, concerns about the "gross" have pushed the monitoring of delivery discipline into the background.

When we shared this thought with Ivan Alekseyevich Abramov, the obkom secretary did not argue: "What do you want? The oblast, and that means us, is evaluated primarily on the sold production volume".

Yes, the notorious gross production still occupies a very important position. By the way, it is true not only at the regional level but at the industry branch level too. Later, at the enterprises, we often ran into situations where the ministries and departments, as well as the local authorities, demand from directors increases first of all in commodity output and sales. And we think that the problem is not only in the psychological backwardness of the bureaucrats. Nobody argues that delivery discipline is an important matter. However, the growth rates for both oblasts/republics and departments/ministries are calculated based on increases in volume of sold products, that is, they are, as before, fully dependent on the cash

value of the commodity products. People are only criticized for breaches in delivery, but for hampering of growth rates they may be even fired. There is a vested interest in each oblast and in each industry branch in having "its own VAZ", which with its hundreds of millions would cover up the debts of dozens of lagging enterprises.

Maybe we should not overestimate the importance of statistical averaging? After all, delivery discipline starts not where accounting is done, but rather where products are made, that is, in plant shops. The new economic mechanism puts the working collectives under conditions such that their material and social well-being depends, first of all, on the delivery discipline, product quality, and resource savings. While the "gross product criteria" still play the determining role in evaluating ministries and oblasts, they are practically unimportant for the enterprises. From next year on, sales volume will become only a calculated parameter, rather than a plan-accounting one. Full-cost- accounting self-financing compels the enterprises to respect business obligations and to generate profits.

Let us take, for example, the same VAZ which became the first enterprise to implement full cost accounting. By fulfilling in practice their delivery obligations, substantially exceeding the planned sales volume, and just slightly reducing costs, the collective exceeded the planned profit by over 30 percent. In accordance with the established norm, one half of the profit is entered into the full-cost accounting profit of the enterprise. The VAZ experience represents an almost classic and indicatative example of the cause-and-effect relationship between the results of production activities for the national economy and the financial situation of the working collective. There is also a no less exemplary case of an opposite nature. The 9th State Bearing Plant of the Minavtoprom [Ministry of Automotive Industry] owes its customers 7 million rubles, experienced increases in costs, and, as a result, lost 3.5 million rubles in profits of which 1.5 million rubles are fines paid for non-deliveries. The enterprise's funds were 60 percent of expected, which limited bonus payments and financing of scientific-research and social measures. The average income in the chronically lagging shops dropped by 20-30 percent.

Analysis of the work of other machine building enterprises shows that delivery discipline and state standards violators in the new economic conditions find themselves in an extremely difficult economic and financial situation with some of them being on the edge of bankruptcy and on special bank crediting programs. Such conditions have befallen machine tool building at the Kuybyshevburmash [Kuybyshev drilling equipment] and Syzranselmash [Syzran agricultural equipment] association, and other collectives. Such a critical situation requires immediate intervention and decisive measures. However, looking at the deceiving averaged statistics, the general situation is quite good. The Kuybyshev machine building complex, in spite of delivery disruptions and increases in costs over planned, has received tens of millions of rubles in above-plan profits since the beginning of this year. It is not difficult to surmise that the same VAZ had rescued the oblast.

In discussions with managers and Party workers of the oblast the leitmotiv was clearly sounded: above all it is Gosplan, Gossnab, and the ministries, in continuing to operate using old and mainly arbitrary methods, who are guilty of putting local enterprises in economic and financial difficulties. For example, the Kuybyshevburmash production association had its 12th Five-Year Plan changed 10 times by Minkhimmash [the Ministry of Chemical Machine Building] in 2 years in the direction of increases in production volume and labor productivity. The enterprise was advised of the last change in June, 1987. As a result, the enterprise finds itself in constant uncertainty. The collective is losing confidence in its capabilities.

Amazing adventures in profit distribution are taking place at the Motor and Tractor Electric Equipment Plant imeni Tarasov. The collective cannot independently realize the program of technical re- equipment and social development as specified for the 12th Five-Year Plan. The reason for it is an obviously low norm (25 percent) for profits being transferred into the full-cost accounting income of the enterprise. Meanwhile, equipment for renovating the shops has been already ordered. Where is the money to buy it? Minavtoprom apportioned 8 million rubles for it this year through central authorities. But what will happen next year?

The plant suggests simply increasing the withholding norm by 8 million rubles. However, the main administration is delaying the decision.

One of the most important parts of the new economic mechanism is the transfer of foreign trade activities to the leading enterprises of the country. However, one can find here also a tendency for the central authorities to limit the independence of the working collectives . Thus, Minavtoprom and USSR Minfin together intend to cut the differential hard currency coefficients by 10 percent. If this measure goes through, VAZ car exports to the CEMA countries will become unprofitable.

The Second Secretary of the Kuybyshev Party Obkom Gennadiy Vasilyevich Khodasevich told us: "In general, the first steps of enterprises on the road to full cost accounting are very difficult. We believe that we must remove all the old barriers which present an obstacle to the work collectives in fully utilizing the advantages of the new economic mechanism".

It is difficult to disagree with this opinion. The economic department of the obkom does the right thing by trying to find the obstacles to full cost accounting. However, while blaming the central departments and ministries, it would be good to sort out the local confusions, mistakes,

and deficiencies, and to uncover internal reserves and possibilities. Financial difficulties of machine building enterprises often appear not because of insufficient profit withholding norms for transfer to the full-cost-accounting income, but rather because there is nothing left to withhold after losses and fines. Enterprises developed a stereotype for explaining deficiencies: supply inadequacies, state acceptance toughness, and shortage of cadres. At the same time, at the Kuybyshev GPZ-9 [State bearing plant], Syzran Turbine Building Plant, and other enterprises, we witnessed scenes of staggering negligence: idle equipment, excessively long shift changes, prolonged lunch breaks, and massive early dismissal of work shifts.

All this is in complete conflict with the serious concerns expressed by the Party Central Committee with regard to the lagging of the machine building complex. It seems that the Kuybyshev obkom did not manage to transfer the momentum from Moscow directly to the working collectives. Why?

13355

Cooperation with West Europe's Black & Decker Viewed

18610079 Moscow STROITELNAYA GAZETA in Russian 21 Nov 87 p 3

[Article by L. Zakharov under the rubric: "Business Contacts:" "Jig Saw: A Complicated Object"]

[Text] **The firm Black & Decker is the largest hand tool manufacturer in the world. It was established in 1910 in the USA. In 1958 the company opened its subsidiary in West Germany, which is specialized in cooperation with socialist countries.**

The General Director of the West German subsidiary of Black & Decker, G. Uhrman said during a press conference at the Moscow Center for International Trade [TsMT]: "The types of ties may be very different. For example, a joint venture was established with Yugoslavia, which exports one-third of its products. We supply parts to Hungary, where they are assembled at the local plants.

Today, our task is to establish contacts with the Soviet Union. We may discuss both the import of our products and establishment of joint ventures. Besides, we ourselves do not have any objections to learn certain things from our Soviet colleagues.

However, the most important thing for us now is to study the Soviet market. We have to find out which tools will be in demand, and how they will work under severe winter conditions."

The small exhibition at the TsMT is called "Black & Decker for all types of production". I asked a representative of the firm, Klaus Eichhorn to comment on the exhibits.

I suggested to him that he imagine that he is a simple consumer who has nothing to do with Black & Decker: "You decide to repair your home yourself. What are the chances that you will buy exactly these tools?"

K. Eichhorn answered: "Judge for yourself. Black & Decker is holding 32 percent of the world market in electric tools. Therefore, simply in accordance with the theory of probability I have a better chance to see them in a store. We will not discuss quality issues. I am afraid, on this issue I will be prejudiced. However, there is another very important issue: Our tools are substantially less expensive than similar products of other firms."

I said: "Let us imagine that this exhibition is a store. What would you buy?"

He answered: "Let us put aside the tools for professionals. So, I would buy this electric drill: for its small size it is quite powerful and uses little energy. An electric plane and an electronically controlled grinder may come in handy. But if I would like to really decorate my home, I would buy this nice thing."

"The nice thing", as it follows from the manual, is designed for sawing wood and in principle could be called a jig saw if not for its appearance: It looks more like a lunar vehicle. . .

My guide asked me: "By the way, have you thought about coffee breaks for me? In this case I will need one more machine."

He smiled and pointed to a coffee maker with a Black & Decker sign on it.

What can I say? One may only envy K. Eichhorn's skills in promoting his products without hard pushing. Now, our specialists have to decide whether the proposals made by the firm are attractive enough, and what the possible ways of cooperation will be.

And who knows, maybe after a certain time, tools with labels "Black & Decker, Made in USSR" will appear in our shops and at construction sites.

13355

USSR-Bulgarian Cooperation in Machine Building, Robotics, Welding

18610163b Kiev PRAVDA UKRAINY in Russian 18 Mar 88 p 3

[Article by M. Znamenskaya, Candidate of Historical Sciences]

[Excerpt] Thirty-six bilateral industry programs are now being carried out on the basis of a Long-Range Program for Development of Economic and Scientific-Technical Cooperation between the USSR and the People's Republic of Bulgaria during the Period up to the Year 2000, which was signed in 1985.

Several joint Soviet-Bulgarian research and production associations have been formed recently in the Ukraine. Among them is an association created by the "Rotor" research and production association in Cherkassy, the robotics department of the Ukrainian Academy of Sciences' Institute of Electric Welding imeni Paton, and Bulgaria's machine-building association SELTO. Similar initiatives have been taken by the Machine-Building Research and Production Association imeni Frunze in Sumy and the chemical machine building complex in the Bulgarian city of Khaskovo, and by the Novokramatorsk Machine Building Plant and a heavy-machinery building plant in Radomir.

A set of robot-equipped welding equipment has been put into series production at the "Beroye" plant in Stara Zagora. This equipment was developed as a result of cooperation between the Institute imeni Paton and the Bulgarian Academy of Sciences' Institute of Technical Cybernetics and Robotics.

The Ukrainian academy's Institute of Problems of Materials Science and the "Metallokeramika" (cermet) research and production complex in Sofia have been cooperating for almost 20 years, which has made it possible to create a well-developed powder-metallurgy industry in Bulgaria. Technological developments of a new electrocontact material which were carried out at the Kiev institute have been turned over to our Bulgarian friends. An economic benefit of 100,000 leva a year has been obtained as a result.

/9604

Effectiveness of Functional Cost Analysis: Problems and Resolution Methods

81442841a Moscow VESTNIK MASHINOSTROYENIYA in Russian No 3, Mar 88 pp 58-62

[Article by B.I. Maydanchik, doctor of economic sciences, and S.V. Shaldenkov, engineer]

[Text] The continuous updating of production hardware and technology and the accelerated creation and introduction of new technology are the main determinant factors in scientific-technical progress.

As experience has shown, functional cost analysis is a tool that facilitates this process. Not only does functional cost analysis make it possible to discover reserves and eliminate superfluous expenditures in existing product designs and technological and production systems, it also prevents irrational decisions from being made when new products are created and ensures that they will be competitive, efficient, and of high quality. "The skillful use of this method of conserving resources in the national economy will have no small effect" [1].

The wider the sphere in which functional cost analysis is used, the more acute will the problem of specifying the limits of its rational use become.

Despite the fact that functional cost analysis has already been in use in our country for a substantial period of time (more than 10 years), in many enterprises functional cost analysis is in its introductory stage as previously, and some enterprise managers remain completely in the dark with respect to the method's essence and possibilities. What conditions can facilitate the effective use of the method in the atmosphere of the active restructuring of our national economy?

The first requisite for the successful introduction of functional cost analysis is that industrial workers feel that the method is beneficial, useful, and honorable for them. Only then will they accept innovation.

The second requisite may be reduced to the fact that engineering and technical personnel should be adequately prepared for this innovation. Above all they need knowledge of the economic bases of production, expenditure-conserving methods, methods of activating creativity, etc. Only then will it be possible for them to master functional cost analysis.

The third requisite is a material base that corresponds to the specified task. The fourth and final requisite is the presence of objective informational data. No matter how well the theoretical apparatus is worked out (as experience with functional cost analysis has shown, it still needs improvement), it will not yield the necessary results without corresponding data base organization and management.

Assessing the extent of an organization's preparedness for the introduction of functional cost analysis evidently requires a set of factors. The most important of these are as follows:

the goals of the organization and its management system;

the qualifications of the executives and labor conditions;

the management style that the organization has adopted and its psychological climate;

the existing communications system;

and the possibility of providing human and financial resources.

Up until now, the disparity between the goals of the method and the economic goals of enterprises has been the main obstacle to the introduction of functional cost analysis. Under the previously existing economic mechanism, enterprises were not interested in reducing production costs. Indeed, reducing production costs often had the following negative consequences for an enterprise:

an increase in output plans (to maintain the production volume that was initially specified in cost terms);

an increase in plan quotas for reducing production costs (from those actually achieved) without making any allowance for products' technical level or the objective possibilities of reducing the expenditure needs to produce and operate them, etc.

The introduction under the new management conditions of the new indicator of specific expenditures per unit of commodity production as one of the capital-generating indicators makes it possible to hope for a change in the attitude toward functional cost analysis inasmuch as it will be possible to focus designers' and manufacturers' attention on the problems of reducing production costs and increasing quality after having reinforced this interest by measures related to appropriate material stimulation.

Some positive shifts in the enterprises' attitude toward functional cost analysis are already evident. Many production associations [PO] and scientific production associations [NPO] have already become interested in disseminating functional cost analysis and using the method in different areas, the necessary attention being given to the organizational measures required to implement these operations. In a number of branches, however, the functional cost analysis method is still underestimated on account of a lack of knowledge about its possibilities and a lack of knowing how to use it.

Sectorial laboratories created for purposes of the methodological direction and management of functional cost analysis operations are trying to eliminate or break up workers in different departments. The functional cost analysis specialists that have completed training at institutes and departments of advanced training are not using information about the functional cost analysis operations that have actually been implemented at enterprises for the purpose that it was intended. Nor are they developing it further or analyzing it, etc. None of this speaks for the method's effectiveness.

Functional cost analysis has already justified its existence, both by the successful results of its domestic trial and by its long-term use abroad.

It is not individual rapid improvements but rather long-term goals that must be considered most important when using functional cost analysis. Only then will it be possible to withstand the practice of "updating becoming obsolescent" wherein specialists bridge gaps but refrain from making radical changes in all spheres of activity.

Japanese business practice has shown that organizational and psychological techniques and tools do more to extract the most of functional cost analysis (which has been used in Japan since 1955) than do methodological techniques and tools.

The impetus to use functional cost analysis is not an order dictating its mandatory use but an affirmation that these problems must be addressed primarily from the standpoint of "whose head will fly off his shoulders if products are too expensive" [2].

The assertion of many foreign economists is that functional cost analysis has made a noticeable contribution to the process of transforming Japan into a serious rival of the leading capitalist nations in the world market (the ratio of the use of functional cost analysis in Japan to its use in the FRG, for example, is 10:1). The ratio of the effect obtained from using functional cost analysis to the expenditures on such operations is 6:1, 10:1, and even 40:1.

In Japan the method is used not only for products already being manufactured but also for products being designed. A high inventive potential, whose development has been stimulated by functional cost analysis, has created a source of continuous improvements and searches for new ideas. Efficiency proposals that are made are initially rewarded with a small sum regardless of the savings in which they result. Then, a group discussion of the proposals is held in Japanese firms, and they are refined—at both the lowest and highest management levels. A final decision is reached only unanimously. The main motto is to avoid everything that does not facilitate an increase in productivity. For this reason, recommendations made during the course of functional cost analysis are taken especially seriously if they facilitate the manufacture of a product with a minimum of equipment, material, and work time. For this, the functional cost analysis system is combined with a quality control system, which makes it possible to discover weak spots in the organization of the production process, the supply of materials and power, etc.

Functional functional cost analysis is also actively used when a new product is created. This form of functional cost analysis, which is frequently termed "creative," is more productive than "corrective" functional cost analysis (which is used to improve a product that has already been launched into production) because during the course of approximately 2 years since the beginning of series production (in the automobile industry, for example) an attempt was made not to introduce any changes into products' design.

When analyzing the effectiveness of functional cost analysis it is necessary to make an allowance for the phase of its development in which an enterprise has resorted to using this method.

Use of the "corrective" form of functional cost analysis (i.e., to improve products being produced and existing technologies) is most characteristic for the initial development phase. In this case functional cost analysis per se does not exert any substantial effect on the organizational development of an enterprise. If an enterprise is in the differentiation stage of its development, the effect derived from using even the corrective form of functional cost analysis is sharply reduced on account of the active resistance to the method that arises. This effect of the bureaucratic apparatus shows.

Finally, the integration phase gives a push toward the use of the "creative" form of functional cost analysis [Footnote 1] (which is usually used in the stages of scientific R&D [NIOKR]) and toward its dissemination into the sphere of production organization and management, thereby effecting the transition of functional cost analysis from the technical planning sphere into the organizational planning sphere.

An analysis of the situation that has evolved in the leading domestic industries makes it possible to conclude that in the majority of these industries there has been a clear turn toward the direction of a transition to a third phase of development—integration. Integration has become necessary under the conditions of the acceleration of scientific-technical progress, the intensification of economic development, the transition to flexible manufacturing systems, and the formulation of the technical base of the plants of the future. Under these conditions, functional cost analysis should serve not only the progressive development of production but also the development of the enterprises and their radical restructuring.

Determining where, when, and how the methodology of functional cost analysis can feasibly be used together with other methods requires having an idea of the results that can be obtained by using different ways of analyzing things and an idea of the expenditures associated with using functional cost analysis.

It should be kept in mind that the effect derived from functional cost analysis includes two categories of components—quantitative and qualitative. Quantitative components (reductions in material-intensiveness, labor-intensiveness, production cost, etc.) are generally taken into account in computations, and special emphasis is placed on them in planning and functional cost analysis accounting documentation.

The experience of the use of functional cost analysis in relation to various areas (from products to organizational management structures) makes it possible to consider functional cost analysis an active tool for reducing the costs of existing production (on average by 10 to 25 percent). This is the first component of the effect derived from functional cost analysis (E_1). In the opinion of a number of specialists, when operations are organized in a rational manner, the functional cost analysis of launch products that have already been launched into production should be repeated every 3 to 4 years.

The second component is the effect derived from increasing the quality of the technical decisions that are made. As is well known, design defects appear primarily during the stages in which a product is launched into production, where the indicators of the production launch curves (including the speed with which the product is launched into production and the expenses entailed in the process) are sharply worsened if the decision has not been worked out adequately. The methodology of functional cost analysis, especially when it is used in the planning sphere (in a functional cost planning [FSP] system) [3] makes it possible to guarantee lower initial values of expenditures per unit of product in the production launch sphere (S_l) thanks to the provision of a product production cost that is close to the value of functionally necessary expenditures S_{fn}. The care with which each function is worked out and the comprehensive justification of the selection of each component in a design based on a start-to-finish functional approach (beginning with the selection of the composition of the necessary power and information conversions and ending with an estimate of the quality of and expenditures related to each function) facilitates a reduction in the number of changes introduced into a design and into the technology used during the course of its being launched. In this context, total expenses and, in a number of cases, the time needed to launch the production of a new product are reduced. The is the second and quite important component of the effect derived from functional cost analysis (E_2). Unlike the first component, which may be computed directly, this second component can only be calculated indirectly [1].

The third component of the effect is that of the savings derived from reducing parametric redundancy and, consequently, the operating expenditures of a product (E_3). In the case wherein an "inverse form" of functional cost analysis is used (when solving the problem of areas in which it is feasible to use an existing object and standardizing it), there is a fourth type of effect E_4—from accelerating the dissemination of innovations in the national economy to using final decisions and products in new spheres of use. In this case the cost reduction is due to an increase in the number of the product's users, the satisfaction of a new need for combinations of existing resources, and an expansion of the scales on which the products whose production has been debugged are produced.

Besides those quantitative components of the effect derived from functional cost analysis that can, for the most part, be computed directly, the effect of functional

cost analysis also has qualitative components. These are generally ignored even though they reflect an important specific benefit of the functional cost analysis method.

One such qualitative component is the value of the increase in information that occurs during the course of functional cost analysis and that accompanies the the process of making well-founded decisions concerning an object and making a model of it. This in turn increases the adequacy with which the object is described and creates the conditions necessary for the multivariant analysis of a product and the selection of an optimal version of the product with an allowance for consumer properties. This advantage of functional cost analysis gives rise to the long-term nature of its effect. The direct determination of its value is difficult. This effect may be estimated by using elements of information theory and a probabilistic approach. The degree to which a product's characteristics approximate its functionally necessary characteristics is another qualitative component of the effect.

When examining the effectiveness of functional cost analysis, one must consider the moment at which the effect is estimated, i.e., the the estimate is being made in the planning stage or after results have actually been obtained. In the former case it is only possible to give a prognostic, probabilistic estimate (even if the necessary value of the reduction in the production costs of the product, process, or structure being analyzed has been previously specified). In the second case it is possible to calculate the effect directly.

The explanation for this should be sought above all in the very essence of the functional cost analysis method. It is no accident that many specialists relate functional cost analysis to heuristic methods, i.e, to those methods that, even when used correctly, do not guarantee that an improved decision will be obtained in all situations. In the opinion of foreign specialists, however, in most cases the degree of risk when functional cost analysis is used does not exceed 5 percent [3].

Despite the probabilistic nature of the method's success, a purposeful functional cost analysis algorithm that is geared toward technical and economic optimization and that is supplemented by a number of modern tools, methods, and formalized procedures makes it possible to take a giant step forward compared with traditional approaches when making decisions and selecting the best ones. On the one hand, such an algorithm may be viewed as an intermediate stage on the path toward automating design operations that yields the practices of a systems, "functional" thinking instead of intuition and subjective thinking. On the other hand, the extensive possibilities of using the decision-optimizing methods afforded by functional cost analysis and its functional orientation makes it possible to also consider this methodology a necessary component during the formulation of design algorithms in the framework of existing automated design systems [SAPR].

One must consider the traditional articles that assist in estimates of expenditures on scientific research works [NIR] and experimental design operations [OKR] as being among the expenses entailed in conducting a functional cost analysis, with expenditures for executives wages (depending on the amount of time they have been involved in functional cost analysis work, their qualifications, and the organization and automation level of labor) being the main component. The correlation between expenditures for functional cost analysis and the effect derived from conducting such an analysis gives an idea of the method's effectiveness.

The results obtained from processing statistical data on 50 works dealing with functional cost analysis that were conducted at a number of enterprises in one of the sectors in which functional cost analysis has still only been introduced on a small scale shows that the greater portion of works deal with uncomplicated products (primarily products intended for cultural and personal use). In this context, the effect ranged from 5,000 to 10,000 rubles in 56 percent of cases, from 10,000 to 50,000 rubles in 17 percent, and from 50,000 to 100,000 in 15 percent. The percentage of objects the functional cost analysis of which resulted in a savings of more than 100,000 rubles is low (only 12 percent). But even these results may be considered satisfactory if one bears in mind that the cultural and personal goods produced (which are produced in small lots) that were subjected to analysis became cheaper and acquired a higher quality and that, having reached the consumer, these goods will help satisfy consumer needs more completely.

Several methods may be used to increase the effectiveness of functional cost analysis and reduce the expenses in making a functional cost analysis. An examination of functional cost analysis and functional cost planning as an integral organizational and methodological tool with a variety of forms and relatively high labor-intensiveness has made it necessary under current conditions to change the design of these methods to a modular design and to automate the execution of their fundamental units.

The modules occupy an intermediate position in the following chain: stage (operation)-module-implementation methods and techniques.

In the general form, such concepts as functional cost analysis (functional cost planning) "algorithm" (i.e., a set of procedures and units arranged in a specified sequence), "module," and "means" of implementing actions may be differentiated by formulating the following questions. In the first case the question is "What is being worked on and what place does it occupy in the general set?" In the second case the question is "What specifically should be done and in what order?" In the third case the question is "Where should the work begin and how should it be done?"

It is obvious that there may be several ways of implementing the actions included in a module. The composition and structure of the modules that are suitable for both functional cost analysis and functional cost planning but that are used in different combinations were specified while making an allowance for the requisites for distinguishing modules [Footnote 2] and the specifics of the units included in the functional cost analysis and functional cost planning methods (33 works on the functional cost analysis method and 35 on the functional cost planning method in accordance with RM 11.-0173.3-85 and RM 11.0173.4-85 were included in the source set of works during the course of the use of these methods). It is proposed that they be selected from the following subdivision:

Information modules (M_y):

-patent and scientific-technical information (M_{y1}); -production design documentation (M_{y2}); -economic production information (M_{y3}); -consumer operating information (M_{y4}).

Expenditure modules (M_s):

-production (M_{s1}); -operating (M_{s2}); -capital (M_{s3}).

Function (purpose, feature) modules (M_F):

-formulation (M_{F1}); -classification (M_{F2}); -decomposition (M_{F3}); -usefulness (value) (M_{F4}); -degree of completion (M_{F5}).

Structure modules (M_W):

-decomposition (M_{W1}); -classification (M_{W2}); -usefulness (M_{W3}).

Idea modules (M_R):

-effects (physical, chemical, etc.) (M_{R1}); -element-by-element (differentiated) (M_{R2}); -comprehensive (integrated) (M_{R3}).

Evaluation modules (M_o):

-criteria (M_{o1}); -differentiated (expert models) (M_{o2}); -integrated (analytical models) (M_{o3}); -optimization (M_{o4}).

Management modules (M_u):

-feedforward (M_{u1}); -feedback (control) (M_{u2}); -integration (M_{u3}); -monitoring (M_{u4}); -unification (combination) (M_{u5}).

The modules' role in the implementation of the individual units of the functional cost planning method is represented in matrix form (Table 1). Table 1 shows the modular design of the functional cost planning method, including analysis of product requirements, formulation of design goals and tasks, specification of functions, design of FM and specification of S_{Fd}, the search for ideas and formulation of versions by function, assessment of the technical and economic level of the versions based on basic F (preliminary), the design of the product's SM and FSM, a cost estimate F and verification based on S_{Flim}, final selection (comprehensive evaluation and optimization) of the version, and functional cost planning modules. Abbreviations: FM, functional model; SM, structural model; FSM, functional-structural model; X, basic modules; V, auxiliary modules; S_{Fd}, allowable expenditures per function.

As the initial experience of using the modules during the course of functional cost analysis and functional cost planning has shown, the evaluation modules (M_{Fo}) are the most frequently repeated, and the decomposition (M_{F3}) and optimization (M_{o4} modules are the most complicated. In this context, the actions included in these modules are viewed as top-priority automation objects. Some data about the distribution of time expenditures to perform the most important functional cost planning actions on a computer in an interactive mode are presented in a list.

Many functional cost analysis and functional cost planning tasks cannot be precisely formulated, which is to say they cannot be performed in accordance with any previously developed plan. So-called expert systems (consultation systems) that include a set of user-specific rules and basic components for compiling "pieces of information" and analyzing them may be a promising direction of "supporting" functional cost analysis in such cases. Such systems are especially effective in the case of multivariant decisions (for example, when formulating the configuration of a product, formalizing a purchaser's oral description of a product, compiling the plan of a product's formal technical description, diagnosing errors, etc.).

The essence of the "configuration" implemented by using functional cost analysis and expert systems is a transformation of a purchaser's wishes into regular selection factors. These requirements then serve as the basis for deriving the structure of a product (specification) with a modified structure or modified components that is suitable for the purchaser.

This requires that the system do the following:

-be based on a a designer's description of the product (its structure should be suitable for description in terms of design components);

-make it possible to configure the product on the basis of established functions;

-group components in a manner that is geared toward the manufacturing process (which is referred to as the "integrated capability" of the configuration method).

One important advantage of expert systems is the presence in them of explanatory components that can be called up by asking the following three questions:

1. What? (The user receives an explanation of individual questions in the dialogue.)

2. How? (The user receives a picture of the logical paths leading to a conclusion, for example, the constraints that would make it impossible to obtain a decision.)

3. Where to? (There is a return to the preceding conclusion and the operation is continued with a new conclusion.)

Similar systems make it possible to include users and their ideas and specifications in a dialogue with executors (designers and technologists) and their vision of a product (from functions to structure). The work is done in an interactive mode [4].

The use of such systems during the course of functional cost analysis and functional cost planning requires changes in the workstations of engineering and technical personnel [ITR]. Here too, however, functional cost analysis must be used in both the stage in which the existing workstation is diagnosed and the stage in which it is redesigned in accordance with the new requirements.

The diversity of the points at which the method is applied, its direction toward optimizing the correlations between the quality with which functions are executed and the expenditures in all of the stages of an object's life cycle, its activation of a creative beginning, and its rational organization of operations make it possible to consider functional cost analysis a necessary method for diagnosing and designing all systems in the spirit of restructuring and the tasks that have been placed before the national economy in the 12th Five-Year-Plan and in the future.

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Footnotes

1. This will henceforth be referred to as functional cost planning [FSP].

2. A module (from the Latin "modulus" meaning "measure") is characterized by its completeness and by its multiplicity of repetition, and it gives a commensurateness to objects and their parts.

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Use of Patent Information in Studying Laser Technology

18610185 Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 1, Jan 88 pp 9-10

[Article by Engineers O.Ye. Laktionova and Ye.I. Grishchenko]

[Text] In order to solve problems of scientifically justified management of development of science and technology, S&T forecasting is necessary. Recently, patent information has been ever wider used in forecasting. It makes it possible to determine the currently attained world level of technology development and trends of and prospects for such development in certain areas.

At PO [production association] "Zhdanovtyazhmash" studies were conducted on developing a methodology for determining prospects for development of laser metalworking technology. The methodology is based on cluster analysis of patent information and choosing priority directions of research.

The studies were conducted on the basis of the association computer center.

As a result of cluster analysis of patent documentation, an information model (structure) of the studied field was derived. It was used for performing a procedure of ranking scientific directions in accordance with their significance in order to determine priority research directions. Methods of expert estimates were used. The expert poll was conducted by questionnaire. Leading specialists in the field of laser metalworking technology participated in the expertise. Correlation analysis was used to assess agreement between experts.

As a result of conducting the collective expertise, individual expert estimates of the identified research structure were obtained. The following list of research directions in the laser technology field was compiled (in the order of diminishing relative importance and priority of financing for the next 3 to 5 years): heat treatment, machining, drilling, welding, inoculation, marking, balancing of rotating parts and surface cleaning.

In the machining field, the following research directions will soon acquire priority importance: joint use of a gas jet that induces an exothermic reaction and a laser beam; of the beam and a press; of an ultrasonic jet of hot gas and the beam; and of the beam and a cutting bit.

Research directions in the field of laser welding of metals have been systematized in accordance with their diminishing importance as follows: joint use of a laser beam and an additional power supply source (non-consumable electrodes or an ultrasound modulator); a laser beam and a chemically active gas; and two lasers.

A methodology for determining prospects for the development of an object of forecasting was developed. It is based on cluster analysis of patent information and choosing priority directions of studying the identified structure on the basis of expert estimates.

Heat treatment using a laser beam is one of priority research directions identified using this methodology. Studies conducted in this direction made it possible to develop a technology of laser hardening and chemical heat treatment of tools.

Experimental industrial tests conducted at the association have demonstrated a three- to fivefold increase in wear resistance of punches and dies of cold forming dies and an increase by a factor of 1.5 to 2 of wear resistance of cutting tools, compared to tools hardened using a traditional technology.

With wide industrial application, annual savings due to the implementation of laser hardening technology and laser chemical heat treatment of cutting tools will reach R100,000.

12770

Latvian Academy's Assembly Views Progress of R and D Complexes, Centers

18610189c Riga SOVETSKAYA LATVIYA in Russian 2 Apr 88 pp 1, 3

[Abstract] The article reports on the proceedings of the annual session of the general assembly of the Latvian Academy of Sciences which took place in Riga on March 31. Summaries are given of a report on the work of the academy's presidium in 1987 by academician V.P. Samson, chief scientific secretary of the presidium; speeches by B.A. Purin, member of the USSR Academy of Sciences and president of the Latvian Academy, Ya.Ya. Okherin, secretary of the Central Committee of the Communist Party of Latvia, and other participants of the session and the assembly's discussion of these speeches.

Reviewing last year's achievements, speakers hailed advances in the field of magnetic hydrodynamics which have made it possible to develop new-generation induction hot-air furnaces, hydrolyzers and devices for orienting parts on assembly lines. It was reported that a series of instruments was developed for determining physical properties of composite materials, that intensive study of electronic processes in organic molecular crystals was continuing, and that substances were discovered which are capable of selectively expanding blood vessels of the heart and brain. Mutually profitable cooperation with research centers and firms of capitalist countries expanded, particularly in the fields of Baltic ecology and development and testing of new medicinal preparations.

Considerable attention was devoted to progress in rejuvenating the academy's membership and to the status of republic interbranch scientific-technical complexes (RMNTK) and other integrated R and D organizations which have been created. It was noted that the average age of 122 doctors of sciences is 58 years, and that the principle of replacing five percent of the academy's scientific personnel with young specialists every-year has not been followed well. Speakers felt that the academy was not taking full enough advantage of the personnel resources of high schools. E.E. Lavendel, corresponding member of the Latvian academy and president of the Riga Polytechnical Institute (RPI), pointed out in this connection that the number of dissertations defended each year at RPI and Latvian State University is approximately equal to the number defended in the entire academy. Lavendel suggested that research associations be created for the purpose of coordinating efforts of high schools and academy and industry-affiliated institutes.

Okherin praised results of an engineering-technological center which has been created in the republic. This center carried out work in the amount of almost 1.3 million rubles in 1987, chiefly to orders of republic enterprises and agencies, and it has begun producing developments of academy institutes and higher schools. The center's divisions are said to include a test facility for robot equipment, where students and industrial specialists receive training. However, the academy has not acted vigorously enough to advance R and D and develop experimental facilities in other key directions, according Okherin.

It was reported that Latvia's six RMNTKs received more attention in 1987. A complex, "Machine Building," has been created with RPI as its chief organization. Organization of a scientific research institute of machine building at this institute has been proposed. Okherin mentioned that broad use of developments of the RMNTKs "Latviyas Biotekhnologiya" (Latvian biotechnology), "Latvantikor"(Latvian anticorrosion) and "Local Information Networks" is in prospect. Outstanding developments of these complexes include a plasma coating process which can be used for both producing and reconditioning parts. Okherin said that introduction of this development is proceeding too slowly, and that

introduction of electronic equipment and methods in the economy also must be accelerated. At present, the performance of RMNTKs depends largely on the activity of their chief organizations, he emphasized. The Institute of Electronics and Computer Technology thus plays an important role in the complex "Local Information Networks," for example, but this institute does not have enough modern technical and engineering equipment for development of high-quality products, particularly switching equipment.

02291

Call for System of Metallurgical Mini-Plants to Produce Special Items

18610189b Moscow IZVESTIYA in Russian 6 Apr 88 p 2

[Article by V. Konovalov, science commentator]

[Excerpt] A well-developed system of service centers for processing products of metallurgical enterprises into forms needed by machine builders [exists abroad]. The first center of this type in our country, "Metallomashprom", appeared only recently. This center which is affiliated with the Ukrainian SSR State Committee for Material and Technical Supply, was created in Kalinovka, near Kiev, to serve machine building enterprises of the Kiev region. But it is only a drop in the bucket for our country.

The Ukrainian Academy of Sciences' Institute of Electric Welding imeni Paton in Kiev advocates the creation in our country of an extensive system of metallurgical mini-plants and even microplants which would be capable of serving large machine-building enterprises or entire regions. Scientists think that a standard plant of this kind should have an electric melting furnace, a machine for the horizontal pouring of metal and units for chill or centrifugal electroslag casting which would make it possible to obtain castings of any shape that require practically no subsequent machining.

The world's first machines for horizontal continuous casting of blanks appeared in our country. They were developed by the Ukrainian Scientific Research Institute of Metals in Kharkov. Only a single machine of this type for pouring steel is in operation in our country, at the Karaganda Metallurgical Complex, and even it is operating below full capacity. Machines of this type are to be used also for pouring cast iron and nonferrous metals, to be sure, but they too are isolated examples. Machine-building plants still do not have a single such machine for pouring steel.

And yet enterprises could cast so-called consumable electrodes, which are needed for electroslag-casting units, from assorted waste products and from scrap metal remelted in electric furnaces. Compact Soviet units based on electroslag crucible melting of metal were developed several years ago. These units make it possible to obtain all kinds of cast shapes and blanks with the most intricate shapes. The Ministry of the Machine-Tool Building and Tool Industry has organized their production in limited quantities. And many foreign firms now wish to buy them. Such compact units are in operation at the Electroslag Technology Engineering Center of the electric welding institute's Special-Metallurgy Pilot Plant. Although this is an experimental production facility and its products are expensive, these units are swamped with orders. It is advantageous for many enterprises to order products of the pilot plant because these clients have been unable to obtain small lots of forgings and rolled products that they need from other metallurgical enterprises.

The USSR Council of Ministers' Machine Building Bureau and the USSR State Planning Committee evidently ought to examine the question of creating metallurgical mini-plants.

02291

Perestroyka's Effect on CEMA Economy, Defense Industry

18610121 Moscow KOMMUNIST VOORUZHENNYKH SIL in Russian No 23, Dec 87 pp 80-85

[Article by Captain 1st Rank, Doctor of Economic Sciences, Professor I. Maslennikov "Strong Alloy: Revolutionary Changes", under the "We Answer Readers' Letters" rubric]

[Text] Our time dictates the need to convert the national economy of the USSR and all fraternal socialist countries to intensive development. But it is impossible to do this without improving their interaction in scientific-technical and scientific-production spheres.

In October of 1987, the 43rd (extraordinary) meeting of the Session of the Council for Mutual Economic Development (CEMA) took place in Moscow. In accordance with its results, additional measures have been scheduled in order to improve the work of Soviet organizations on fulfilling the Integrated Program of S&T Progress of CEMA Member-Countries. Nowadays, international combination of S&T potentials of CEMA countries is not just a prerequisite for improving the efficiency of utilization thereof, but also a common condition for economic growth based on a modern technical foundation.

There is another aspect to the problem. It is well known that our country stands for stopping the use of science for military purposes. But as long as there is a danger of war and social revenge remains the pivotal point of Western strategy and militaristic programs, we shall keep doing everything in order to keep our defense power at a level that precludes imperialism's military superiority over socialism.

Thus, under the current conditions of increasing danger of war socilaist countries are forced to implement S&T achievements for strengthening their defense capability as well. Acceleration of S&T progress is an important factor of defense power.

S&T progress has a double effect on the military technical development. First of all, innovative scientific and technical solutions and the leading position in defense production technology ensure combat readiness of armed forces with a smaller number of military personnel and lower amount of arms.

Secondly, a well developed technology helps overcome possible consequences of a probable enemy coming up with tehcnological innovations. In other words, technical leadership makes it possible to rapidly and efficiently react to enemy's "technological surprises".

In the socialist community, a reliable spring-board for acceleration of the scientific and technical progress has been created. The community has a huge S&T potential, which is not inferior to the potentials of leading capitalistic countries, as far as quantitative characteristics are concerned. Thus, over 5.2 million people work in the sphere of science and scientific service, including 1.7 million scientific associates. As far as the share of investment in science, CEMA countries are among the most developed countries on Earth.

At present, the share of the USSR and other socialist countries in the world's inventions portfolio is close to 40%. In other words, almost every other invention in the world belongs to countries of the socialist community. A well developed system of bilateral and multilateral S&T cooperation has been developed between CEMA countries. They have signed around 300 multilateral agreements and contracts for collectively solving S&T problems. Over 3,000 research organizations participate in the cooperation.

However, one cannot evaluate one's achevements using yesterday's yardsticks anymore. Today's criteria are defined by tasks set by Party Congresses in the fraternal countries: elevate their national economies to a qualitatively new level. From this standpoint, the pace of S&T and design and planning work as well as the development and production implementation of new technology does not meet today's requirements. Unutilized technical solutions are being accumulated; among these solutions, there is tecnology which is not inferior, and in some cases even superior to the world level.

The June (1987) Plenum of the CPSU Central Committee analyzed the country's economic situation at the threshold of the 1980's and noted that the lag in S&T development as the most worrisome phenomenon. Moreover, socialist countries are far from full utlization of available opportunities for joint solution of urgent S&T problems.

By the year 2000, CEMA countries are planning to double their production volume, while radically improving production output structure and quality. It is impossible to realize these far-reaching plans, and in such short time at that, using the old technical base. This can only be achieved by making revolutionary changes in S&T progress and by converting from the old to a new generation equipment and from the existing to a new in principle technology.

This is why under the conditions of restructuring [perestroyka] the need has ripened to renew forms and methods of cooperation of the fraternal countries in accordance with the current demand for acceleration of S&T and socio-economic progress. The goal of the day is, using collective efforts, to provide a frontal technological breakthrough and thus accelerate as much as possible S&T progress, and in some cases revolutionize production.

The Integrated Program of S&T Progress of CEMA Member-Countries up to the Year 2000 adopted by the CEMA Session in 1985 marks a qualitatively new stage in the interaction of the fraternal countries. As far as its scope is concerned, it surpasses all known international projects, as it covers 93 large-scale problems. For each of the problems one has to conduct a wide range of research and development that will make it possible to advance to the highest level of science and technology.

This document has consolidated the previous agreement on the development and implementation, as soon as possible, of new in principle equipment and technology. This is ensured by joint concentration of material and intellectual resources along five directions that form the foundation of current revolutionary changes in science, technology and production: electronization of national economy; integrated automation; nuclear power; new materials and technology for manufacturing and processing thereof; and biotechnolgy. These priority directions form the basis for the development and implementation of coordinated S&T policy by the fraternal countries.

It is well known that all developed countries are involved in the S&T revolution at the same time, which brings about a large number of diverse directions of the S&T progress. However, production efficiency is far from being always the same. Therefore, the fraternal countries first of all concentrate their effort on those directions that ensurethe highest economic efficiency. The Integrated Program does make it possible to convert, along these directions, basic scientific ideas into concrete advanced technologies and develop new generations of high-efficiency machines and newest materials. It is through such integral combination of science and production that economic and social efficiency is achieved.

In order to fulfill the Integrated Program, it is important to follow the principle of continuity, of joining various links into a continuous chain "Science - Technology - Production - Sales". This presumes smart use of effort

and resources at each stage. The thing is that, due to their extreme complexity, modern research and development require intellectual and material resources so large that as a rule they exceed capabilities of any single country. And if each country goes through these stages on her own, it will, willingly or unwillingly, duplicate the work of other countries, while spending tremendous resources. And vice versa, if a country concentrates her effort and resources on certain works while other countries concentrate theirs on other problems, this reduces expenses tremendously. Time is gained and production runs become longer, which, of course, results in large savings for national economy.

Practical orientation is a characteristic feature of the Integrated Program. Whereas up until now S&T cooperation only involved the development of engineering documentation or building experimental prototypes of machines, technology and materials, the Program's end goal is a rapid and broad-scale mastering of production and organization of mutual deliveries. During the current Five-Year Plan, development of over 40 problems of the Program must result in manufacturing of newest products, and the scale of implementation of jointly obtained results will increase year after year.

Basic research forms the foundation of the acceleration of S&T progress. It is this research that determines society's transfer to a qualitatively higher level, which makes it possible to develop new in principle technology and materials.

What is the situation in this area? Nowadays, Soviet science exceeds the world level in many areas. It has fundamental achievements in space exploration, mathematics, information science and computer technology, robotics and machine science, nuclear and elementary-particle physics, quantum electronics and optics and in solid state physics. Serious results have been derived in physico-chemical biology, biotechnology, exploration of mineral resources, mining and complex utilization of mineral raw materials, research of inorganic materials and chemical technology processes.

Thus, basic research forms the foundation of S&T work on developing newest technology and equipment that ensure increased labor productivity and effective defense. Solving the problem of barring the military and technical superiority of NATO countries over socialist states depends to a large extent on basic research and on completeness of identification and utilization of its capabilities for developing necessary arms and military equipment.

Computers, Robots and Nuclear Power Plants

It has been noted earlier that with the support of basic research, CEMA countries are concetnrating their effort on high-priority directions of S&T progress. The highest priority is given to electronization of national economy, because utilization of its achievements is the governing factor in the progress of other sectors. Electronization ensures that machine building industries in the fraternal countries will get to the forefront of the technical progress. And renewal of products of the machine building industry puts state-of-the-art retooling of production facilities on a practical footing.

CEMA countries have accumulated vast experience in joint design and mass production of computer equipment. During the last 15 years, they have collectively organized series production of the first, second and third generations of YeS universal computers, as well as mini- and personal computers. Over 500 of most sophisticated modern computer devices have been tested and put in production. In the USSR, for instance, universal computers that execute 125 million instructions per second have been developed and are series-produced. Technical parameters of computers have improved by several orders of magnitude. This has formed a solid foundation for further development of electronization.

The question now is to develop a new, fifth generation of high-efficiency supercomputers capable of executing 10 billion instructions per second and use AI principles. These computers will form the basis of large collective-use computer centers. The scope of application thereof keeps expanding. They will make it possible to sharply reduce the time and labor required for solving complex simulation problems and perform calculations and design. They will also make it possible to solve problems that were heretofore off-limits for a researcher.

In order to automate work stations and implement their mass application as controlelrs, it is planned to develop a wide range of microprocessor-based microcomputers. They will also be used as personal computers and intellectual terminals in scientific research organizations, in educational institutions and at home.

Mini- and microcomputers play such an important role nowadays because, due to their simplicity of operation, they are less expensive and much more user-friendly than universal computers. Computers with built-in microprocessors sort of acquire new qualities, as they become more precise and productive. This makes it possible to develop improved technology, improve product quality and reduce material and energy consumption.

The second high-priority direction, integrated automation, is closely related to electronization of national economy. It is especially important for fraternal socialist countries. One of the most important social goals of the socialist society is to make people's work easier and creative. Thus, in accordance with resolutions of the 27th CPSU Congress, the share of manual labor in the USSR will be reduced by the year 2000 by more than 50%. This will free over 20 million people from low-skilled labor.

We shall now discuss interaction of the fraternal countries in manufacturing of industrial robots. This is very expensive equipment, and CEMA countries are trying to develop robots according to a unified concept and unified standards. They operate an international scienfic-production association "Interrobot"; Bulgaria, Hungary, Cuba, Poland, USSR and Czechoslovakia are the association members.

Commissioning specialized capacity for manufacturing of industrial robots will result in a sharp increase in their quantity and quality level as early as during the current Five-Year Plan. Whereas in 1985 the fleet of industrial robots in CEMA countries included over 50,000 units, by 1990 it will include as many as 200,000. In the USSR alone, their number will triple. Dynamics of cooperation development in this field is demonstrated by the fact that mutual deliveries of robots during the current Five-Year Plan will increase tenfold, compared to 1981-1985. Over 70 scientific research institutes, production associations, combines and enterprises of member-countries participate in the implementation of the "Interrobot" program.

The accelerated development of nuclear power is the third high-priority direction in cooperation of CEMA countries in accordance with the Integrated Program. Power generation at AES will reach 30 to 40% of the total volume of power generated in our countries. In essence, this amounts to creation of an integral nuclear power complex of socilaist countries.

The agreement on multilateal specialization and cooperation in manufacturing of AES equipment in 1981-1990, signed by CEMA countries, is being successfully implemented. As far as its scope and the number of participating countries, it has no analogs in world practice. Today, their in-house production completely satisfies their demand for specialized modern equipment.

Composites for "Ruslan"

Conversion of national economies of socialist countries to intensive expansion is accompanied by the development and mastering of entirely new materials, and tecnologies for manufacturing and processing thereof. Within the framework of the fourth high-priority direction, CEMA countries have defined their own method for joint solution of this urgent problem.

Specifically, we are talking of new in principle methods for metal treatment at the molecular and atomic level, which increase labor productivity by one or two orders of magnitude. The cooperation provides for joint production of new types of polymers, plastics and chemical fibers that can be used under extremal conditions, including aggressive media and tropical conditions. Of great interest are joint development of composite materials based on combining two different substances (such as metal and glass, metal and ceramics or mineral fiber and plastics), one of which is the main one.

Development and industrial implementation of composites generate substantial savings. They are widely used in the aerospace industry. For instance, our largest aircraft "Ruslan" has around 3,000 parts made of composites. This made it possible to save 15 t of metal, as well as 18,000 t of fuel over the service life. Labor content of these parts has been reduced by 50%, and the number of purchased components by a factor of 12. The situation with IL-96 and TU-124 airliners is similar.

CEMA countries attach special importance to accelerated development of biotechnology, the fifth and the newest high-priority direction of S&T progress. According to professional estimates, its effect on transformation of technical fundamentals of production in the 1990s could be comparable to the current effect of electronics. By synthesizing the newest achievements in microbiology, genetics, biochemistry, physiology and a number of other sciences, biotechnology opens up real opportunities for increasing food reserves, bringing public health service to a higher-quality level and improving environmental conditions.

In essence, realization of the five high-priority directions in cooperation of the fraternal countries means transition to a qualitatively new stage in their integrated S&T interaction.

Strategic Goals

The new stage in S&T interaction needs an appropriate mechanism.

For a long time, there has been a gap between S&T and production cooperation. Today, cooperation of prospective manufacturers is being enlisted at the design stage of development of S&T documentation. Consequently, a mechanism that covers all work stages and clearly defines and organizes the development of scientific and production cooperation is being formed.

Due to the radical reform of management of the USSR national economy and substantial changes in business mechanisms in other European socialist countries, favorable opportunities for a more profound S&T interaction are opening up. The June (1987) Plenum of the CPSU Central Committee noted that restructuring of economic management opens up a broad space for the development of international cooperation. "It is quite obvious that the success of perestroyka in our country determines to a large extent a higher efficiency of economic and S&T cooperation with fraternal countries", the CPSU Central Committee Plenum stressed.

In the USSR and other socialist countries, powers of business and S&T organizations are being expanded. Direct links between local production and research organizations are becoming effective means for establishing stable S&T cooperation between the Soviet Union and

other countries of the socialist community. The international scientific-production association "Robot" was among the first such associations in the socialist community.

Two joing Soviet-Bulgarian scientific-production associations (NPO) were formed in the machine building industry. One is the Ivanovo Machine Tool Building Association and State Business Association "Zavody metallorezhushchikh stankov" [Metal-Cutting Machine Tool Plants] in Sofia. The other one was established by Moscow Machine Tool Production Association "Krasnyy proletariy" and Robotics Scientific-Production Combine "Beroe" in Stara Zagora.

One can judge the capabilities of the two joint NPO in supplying new highly efficient equipment for machine building industries of CEMA countries from the following data. On the Bulgarian side, practically all production enterprises and scientific institutes involved in production of metalworking equipment participate in the process, and on the Soviet side, 40 plants and 7 scientific research and design planning organizations take part. Such powerful scientific-production base makes it possible to fulfill complex assignments and achieve a high rate of manufacturing of newest equipment.

At present, effectiveness of cooperation depends to a great extent on whether it results in making higher class products and mastering advanced technology, in other words, in S&T progress. Said Comrade M.S. Gorbachev: "There is nothing more fruitful and advantageous nowadays than joint work of scientists, designers and developers along the decisive and most advanced directions of S&T progress".

Soviet science and industry take the central place in the realization of the Integrated Program of S&T Progress. Functions of head organizations-coordinators for all 93 problems under development are performed by Soviet research, design and scientific-production collectives, as the most powerful and competent. Not only is this the sign of appreciation of achievements of Soviet science and technology and the power of their research potential, but it is also a convincing proof of the international responsibility of the USSR for practical implementation of collective plans.

Functions of head organizations for a number of high-priority problems are performed by intersectorial S&T complexes (MNTK) that include institutes, design bureaus, experimental production facilities and experimental plants. Among these are MNTK that have been created on the basis of the Electric Welding Institute imeni Ye.O. Paton; Informatics Problems Institute, AN SSSR [USSR Academy of Sciences]; Experimental Scientific Research Institute of Metal-Cutting Machine Tools etc. Today, there are over 20 MNTK in our country. Their activity brings about great expectations of acceleration of the development of new ideas and especially of implementation of S&T achievements.

CEMA countries have set for themselves a strategic task: to achieve revolutionary shifts in science and technology. Close cooperation that multiplies the economic and defense potential of the socialist community is an important factor in counteracting the aggressive strategy of imperialism. Solving the set tasks will facilitate further development of national economies of the fraternal countries and improve their defense power; in the end, it it will strengthen socialism's positions in the world and increase its influence on the entire world development process.

12770

Improved Maintenance Service: Important Reserve for Raising National Economy Effectiveness

81442186a Moscow PLANOVOYE KHOZYAYSTVO in Russian No 8, Aug 87 pp 118-120

[Article by K. Sarsembayeva, Junior Scientific Associate, NIIEPiN [not further identified], Gosplan, Kazakh SSR, under the "Readers' Suggestion" rubric]

[Text] At this time of converting country's economy to an intensive path, it is ever more important to maintain the active portion of fixed production assets of national economy in working order by performing regular repairs of machines, equipment and instruments. Forty percent of machine tools in the country are making spare parts, whereas the volume of products, manufactured with this equipment, is a bare 15 percent of the gross product of the machine building industry (see PLANOVOYE KHOZYAYSTVO, 1984, No 6, p 11). Increasing material and labor expenditures and monetary expenses for equipment restoration have become a major factor that negatively affects end operating results of sectors of national economy. Currently, these expenses exceed 60 billion R annually.

In the Kazakh SSR, there are 50 machine building enterprises with Union subordination. Each enterprise has its own repair department. Inspection of 29 repair departments in various machine building subindustries has demonstrated that they have from 200 to 10,450 pieces of installed production equipment. The share of physically worn and morally obsolete equipment (over 20 years old) in the total fleet at inspected enterprises is equal to 12 percent. In some cases, the cost of general overhaul of a metal-cutting machine tool over its service life exceeds its initial cost. According to our calculations, repairs of obsolete metal-cutting equipment at machine building enterprises in the Kazakh SSR results in losses for national economy, equal to 32.1 million R.

On the average, the share of metal-cutting equipment in the overall fleet at inspected enterprises is equal to 50 percent. Its repairs constitute the major part of the total volume of repair work. However, a bureaucratic approach to the repair of sophisticated machinery and equipment, the existence of a large number of small unprofitable repair enterprises and dissociation thereof impede performance of high-quality and timely equipment repairs.

It is well known that having in operation various equipment models significantly impedes specialization of repairs. At the Republic enterprises, the number of models of metal-cutting equipment is very high. In particular, there are 301 models at the Vostochno-Kazakhstanskiy Machine Building Plant, 312 at the Production Association "Tselinogradselmash" and 593 at the Production Association Pavlodar Tractor Plant. There are 34, 28 and 27 models of lathes, respectively.

In the Kazakh SSR, as well as in the country as a whole, equipment and machine tool customers restore them, as a rule, themselves, which results in dissipation of resources of all types, especially because of the large territory of the Republic. Metal-cutting equipment is mainly concentrated in cities, especially in large ones, such as Alma-Ata, Karaganda, Pavlodar, Ust-Kamenogorsk and Chimkent. They are located far apart (from approximately 500 to 2,000 km). The problem of shipping spare parts and materials for repairs is not only aggravated by increasing freight costs, but also by considerable inconvenience, such as installation and dismantling of machine tools, loading and unloading and long in-transit time.

Analysis demonstrates that the fleet of metal-cutting equipment at ministries and agencies, subordinate to the Kazakh SSR Council of Ministers, is small. Thus, one of the largest ministries, the Ministry of Local Industry (Minmestprom), has 1,767 pieces of equipment and only repairs seven machine tools of the same model a year. It is not feasible to centralize the repair of this number of machine tools. According to calculations, performed by the Experimental Scientific Research Institute of Metal-Cutting Machines Tools, Minstankoprom SSSR [USSR Ministry of Machine Building and Machine Tool Industry], there must be at least 100 pieces of equipment a year in order to create specialized repair enterprises. In many cases, intraindustry specialization of equipment repairs in Kazakhstan is inefficient. But practice demonstrates that this is the most "painless" way, so ministries prefer it.

It is our opinion that in the Kazakh SSR interindustry centralization and specialization of repair of metal-cutting equipment is the most reasonable form. There are 11 Minstankoprom repair plants in the country: four in the Ukraine, one in Latviya and the rest in the RSFSR. Kazakhstan (except the Ural oblast, assigned to the Michurinskremstanok plant in the Tambov oblast) is in the service zone of the Novosibirsk plant Sibremtochstanok. The cost of a general overhaul of a piece of equipment at these enterprises, including freight charges, is from 1,400 to 5,300 R. In some cases, it is as high as 12,000 R. Services of field teams of repair plants are also expensive. However, equipment customers are forced to use these services, because the primitive condition of their own repair departments does not make it possible to perform high-quality general overhauls.

The share of freight charges in the Kazakh SSR in total expenditures for equipment restoration is high. The length of hauling machine tools and equipment is high too. Here are specific examples. The Kentau Excavator Plant uses services of the Sibremtochstanok plant. Equipment is first hauled to Chimkent, then shipped 2,433 km by rail. Thus, in 1981 specialized repair of a machine model N481A cost the Kentau plant 11,961 R. Vostochno-Kazakhstanskiy Machine Building Plant repairs 10-15 lathes, model 1K62, annually at the Snezhnyanskremstanok plant, located in the Donetsk oblast. Lathes are hauled 4,470 km. The Alma-Ata Heavy Machine Building Plant (AZTM) has been hauling four-five pieces of equipment annually to Novosibirsk for restoration for 7 years. The cost of a general overhaul of a lathe (including freight charges) is 1,400-1,500 R. Monetary expenses are relatively low, but the repair time is very long: one year on the average. One-way hauling takes almost 90 days. The Republic Ministry of Automotive Transportation (Minavtotrans) only assigns 40-50 repair workstations annually for repairing motor vehicles, operated in the Republic Ministry of Local Industry system. Even in the case of the most efficient distribution of the repair fund, defective vehicles must be hauled for restoration from Taldy-Kurgan to Aktyubinsk. The distance between the two cities by road is 2,368 km, including 600 km of country roads. In other cases, defective equipment is hauled from Chimkent to Pavlodar (2,133 km). Minavtotrans justifies such long-distance hauls by specialization of its repair plants. Savings for one agency result in increased expenses for another.

Under the conditions when transportation has become a bottleneck in the development of national economy, new inefficient shipments are intolerable. It is therefore necessary, also from the standpoint of rationalizing the transportation network, to direct the effort to organizing interindustry centralization and specialization of repair.

It must be noted that the nomenclature of equipment, repaired by specialized enterprises, is very limited. For instance, the Sibremtochstanok plant repairs coordinate-boring machines, but it does not repair even such widely used equipment as drill presses, milling and gear machines. The low quality of repairs brings in frequent complaints. We think that the practice of State acceptance of products at enterprises should also cover repair plants.

The share of products of the machine building industry in the structure of industrial production in Kazakhstan is equal to 16.4 percent. In the Ukrainian SSR, this index is close to 30 percent. In this respect, only the Turkmen and Tadzhik SSR are behind the Kazakh SSR. As far as the level of technical equipment and organization of repairs, the Kazakh SSR is among the last Republics.

NIIEPiN, Gosplan, Kazakh SSR, has developed justification of the feasibility of creating two specialized enterprises for repairing metal-cutting equipment in the towns of Abay (the Karaganda oblast) and Kapchagay (the Alma-Ata oblast). The industrial and production personnel for these plants could be comprised from the personnel of repair departments of these towns' enterprises, because 30-35 percent of repairs should be performed in specialized conditions. In this case, it would be possible to use the freed-up capacity of repair departments for increasing the output of main products and consumer goods, such as, for instance, equipment for the coal mining industry in Karaganda, erosion-protection equipment in Tselinograd and consumer goods in Pavlograd. Centralization of equipment repair in the Southern Kazakhstan would make it possible to increase production of rolling mills, metal-cutting machine tools and spare parts for agricultural machinery in Alma-Ata and of urgently needed automated presses in Chimkent.

The demand of the national economy of the Republic for specialized repairs of equipment is high, and it will keep growing. Therefore, in the structure of proposed repair enterprises one should provide for organization of field repairs, as well as plan higher production volume of spare parts (for restoring worn-out parts) than is the practice at the existing plants of this type.

In the General Schedule for the development and placement of plants for general overhaul of metal-working machine tools, developed by the Experimental Scientific Research Institute of Metal-Cutting Machine Tools, it is planned to create a specialized enterprise in the Central Kazakhstan. This enterprise could combine general overhaul of equipment with equipment modernization. It would be expedient to merge this enterprise with local project, design and scientific organizations and VUZs and form an interindustrial scientific and technical complex.

In the Kazakh SSR, metal-cutting machine tools and press-forging equipment are manufactured at the Alma-Ata Machine Tool Building Plant imeni the 20th October anniversary ASZ) and at the Chimkent Production Association. High-quality repairs should be organized at these enterprises. To do this, one should provide for additional capacity in plans for reconstruction and retooling of these enterprises. At present, reconstruction at the ASZ is in full swing. Unfortunately, organization of high-quality repairs is not in the making. Now is a good time to correct the renewal project. Restoration of CNC machine tools is an urgent problem in the Republic industry. The question of creating a center for maintenance and repairs of these machine tools in Alma-Ata and corresponding departments in Karaganda, Pavlodar, Ust-Kamenogorsk, Chimkent and Aktyubinsk is ripe.

It should be emphasized that, unlike in the case of metal- and wood-working equipment, there is a wide network of enterprises for repairing agricultural equipment: there are 146 of them in the Republic (as of 1 January 1985). But investment in the creation of the Republic Agroprom [State Agroindustrial Committee] repair plants has not been producing adequate return yet. On one hand, this can be attributed to the fact that kolkhozes and sovkhozes are trying to restore machines, using their own resources, and use services of specialized enterprises only in extreme cases, because the quality of equipment repairs at these enterprises is most often unsatisfactory, and hauling of equipment causes a lot of troubles. The demand for spare parts for agricultural machinery is much higher than for the repair itself. On the other hand, the reason for underutilization of repair plants and shops is the shortage of spare parts, metal and other material resources.

Four enterprises of the Kazakh SSR Gosagroprom repair metal-cutting tools, along with agricultural equipment. Thus, in 1984 Production Association "Remselmash" restored 223 machine tools, the Ushtobinskiy (experimental) Repair Plant - 205, the Uralsk Repair Plant - 123, the Smirnovskiy Repair Plant - 60. One should increase the volume of equipment restoration at these enterprises by putting equipment restoration on the interagency basis.

In order to solve regional problems of equipment repair and utilize available reserves, one should combine the effort of local bodies, territorial material and technical supply administrations, scientific research institutes, VUZs, scientific and technical societies and other bodies.

However, local initiatives and efforts of public organizations alone would not ensure the radical restructuring of the repair business. The restructuring must become an object of planning, with centralized allocation of resources. At present, a large number of industries underutilize resources, allocated for equipment and machinery restoration. Republic Ministries have especially hard time in putting the money to use, due to the lack of skilled repair personnel, necessary equipment or appropriate technology and for other reasons. Therefore, money that has not been used is diverted to building repair. There are cases of money underutilization at machine building plants too. In our opinion, it makes sense to charge Territorial Planning Departments of oblast Plan Commissions with planning the repair subindustry. At the Union Republic Gosplan [State Planning Commission], the Department of Balances and Plans for Distribution of Equipment and Machinery should plan the repair business.

Implementation of measures for ensuring efficiency of the repair business is urgent. One cannot accuse Kazakh SSR Union-Republican and Republican ministries in the lack of activity when it comes to improving equipment repair. Industry searches, be it studies, conducted at Minmestprom, or group centralization of equipment repair at other agencies, prove the need to combine efforts of individual Ministries. To coordinate their activity, an interindustrial body for managing the repair industry is needed. On the country scale, there is a need now to develop and implement a goal-oriented integrated program for improving the repair business, using the latest achievements of the scientific and technical progress.

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Equipment Renewal and Ways to Extend Equipment Service Life

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[Article by A. Gaponenko under the "Readers' Suggestions" rubric]

[Text] The course for accelerated technical restructuring of the national economy, developed by the Party, presumes fast renewal of means of labor. By now, a lot of obsolete and physically worn fixed production assets have accumulated. Therefore, the reproduction process must be brought into the state of constant renewal; fixed assets will be getting proportionally bigger and will be replaced at a rate that would ensure the maximum efficiency of their functioning.

The problem of optimizing the service life of means of labor is not the one that has just surfaced. However, the conditions of renewal of the country's production facilities force one to look at the problem from a different standpoint. How the goals of accelerating the social and economic development affect criteria of the optimum service life? What are the qualitatively new features of renewal of labor tools under current conditions? What is behind the very concept of service life optimization? It is urgent to examine these problems.

The optimum service life of labor tools is a historic category. Specific criteria for determining it depend on specific features of the reproduction process as a whole. At various development stages of the socialist economy, renewal of fixed production assets was occuring at different rate and performed by different means. During the first Five-Year Plans, the renewal was mainly occuring due to the fast growth of fixed assets and adding newly created assets to existing ones. During the industrialization period, the main goal was to change from manual labor to machine production. Newly created or purchased abroad equipment was most efficiently used at new workstations. Under those conditions, old machines were repeatedly restored, whereas the machine building industry was supporting expansion of the machine fleet. The optimum service life from the standpoint of main objectives of that time and the optimum service life as defined by current criteria are different, the former being much longer. Thus, at present the reduction in the service life of labor tools occurs not only due to the increasing obsolescence, but also due to the radically changed character and contents of the entire production process.

Renewal of means of labor must not only ensure the growth of the economic, but also the social efficiency of functioning of production facilities. The optimum equipment service life is affected by both physical wear and obsolescence, including their social form. If as a result of physical wear social characteristics of equipment deteriorate (a higher danger of traumatism, increased level of noise and vibration, newly created or increasing environmental pollution), this will expedite its replacement. Maximum permissible standards of labor and environmental conditions must be among the main factors that determine the optimum service life of machinery. These standards are mobile; they are periodically reviewed, resulting in the so-called social obsolescence of existing means of labor and in some cases in accelerated replacement thereof with new equipment that has better social characteristics.

Social factors that determine equipment service life warrant special consideration. Standards that are part of the system of GOSTs [State All-Union Standards] are progressive, as they are aimed at newly developed technology and at operations that are under construction or reconstruction. Taking into account social factors in determining the moment for replacing old machinery calls for formation of a stringent system of standards, in the first place labor conditions standards. If equipment does not meet the standards anymore, it must be either modernized or replaced.

Obsolescence does not unambiguously determine the service life of all labor tools of the same type. A machine that is not profitable to operate at one workstation can be suitable at another one. At present, a large number of means of labor, such as locomotives, electric power plants, aircraft, turbines, metal-working machine tools etc., as they gradually become obsolete, are transferred to less critical production areas. For instance, large quantities of retired metal-working equipment is transferred every year from machine building enterprises to non-machine building industries. These are obsolete machine tools that are unprofitable to operate in the machine building industry, but can be successfully used in the repair business or in ancillary production, where equipment load is insignificant and technical requirements to equipment are lower.

Not only will the expansion of the practice of redistribution of used equipment improve efficiency of its utilization, but it also will produce substantial savings in repair

costs. For instance, in tractors that are written off only some parts should be scrapped, the rest can be successfully used for repairing existing machines. If written-off tractors are sent to repair enterprises, country-wide savings, generated due to utilization of good parts, will equal 150-180 million R annually.

Redistribution of used equipment does not mean its accumulation. If the equipment is completely worn out or obsolete, no redistribution can correct the situation. In this case, the equipment must be retired.

The scientific and technical progress has a dual effect on the optimum service life of means of labor: on one hand, it increases it by improving strength, durability, reliability and repairability; however, on the other hand, it reduces it by accelerating the rate of obsolescence. So for some machines their optimum service life increases, whereas for other machines it decreases. The length of these periods changes, depending on conditions, a lot of which (such as reliability, repairability, operating expenses etc.) can be purposely changed. Because of this, the problem of optimizing this process arises. What is the direction of feasible changes of the optimum service life of labor tools? The direction of these changes is different for different types of equipment. The general solution of the problem is to bring in line the length of equipment physical wear and obsolescence. For some machines, their actual service life should be increased, for other ones it should be reduced. And one must provide appropriate preconditions for expanding the production of means of labor (or reducing the fleet size) in the first case and improving equipment durability, reliability and maintenance in the second.

The principal regularity of the current development is the accelerated rate of scientific and technical progress that increases the effect of obsolescence of means of labor on the reproduction process, which leads to a shorter optimum service life thereof. However, when equipment wears out physically faster than it becomes obsolete, then measures, aimed at increasing its life, improve efficiency of its utilization. But for the time being, national economy losses due to premature write-off of machinery are commensurable with losses due to obsolescence in the case of excessively delayed replacement thereof.

In recent years, a basically positive trend of increasing the average actual service life of certain types of agricultural machines has formed. However, for a large number of these machines it is necessary to bring this life up to standards, first of all by improving operating conditions and quality of the machines. It is necessary to increase the self-supporting interest of kolkhozes, sovkhozes and interbusiness enterprises in efficient utilization of and thrifty attitude toward equipment and to expand the practice of personal assignment and renting of equipment.

One can consider two interrelated aspects of service life optimization. The first aspect is optimization of the service life of each individual labor tool. In this case, one takes into account specific operating conditions, including requirements of individual workstations, as well as individual features that have formed in the process of operation. The second aspect is optimization of the service life of labor tools that have a given functional purpose, taking into account average operating conditions of the entire fleet of equipment of this type.

The optimum service life of machines is a characteristic of their use value. Differences between the optimum service life, determined for a singular labor tool and for all similar labor tools of the same type, are due to differences between their individual and aggregate use value. The most feasible service life of a specific machine depends on its operating conditions and technical and economic features (i.e. productivity, capacity etc.), determined by its original properties and specific features of application. The optimum service life that characterizes all equipment of a certain type depends on conditions of reproduction of the entire fleet and is specified as the mean of all optimum service lives of labor tools that comprise the fleet. This life determines conditions of maximum efficiency of functioning of the entire fleet.

The optimum operating period of a specific labor tool and mean optimum service life, which characterizes the entire fleet, can be different. Their functions are different too. Mean optimum service life can be used in determining the scope of depreciation and in planning the volume of equipment production and renewal (particularly, when planning equipment retirement). Every time one has to make a decision whether to continue to operate, to replace or to modernize a labor tool, it is important to proceed not from mean optimum service life, but from specific production and workstation conditions. In this respect, one should consider as faulty the practice of unconditionally writing off equipment, when its actual age exceeds the standard. The degree of physical wear and obsolescence only indirectly depends on the age of a labor tool. Therefore, when planning equipment replacement, the fact that the standard service life has been exceeded should not be the sole basis for making the decision on feasibility of retiring it.

For each individual labor tool, it is important to proceed from specific production and workstation conditions. As a rule, specific conditions deviate from average ones, therefore an individual optimum service life can differ considerably from an averaged optimum. Mean optimum service life can only play the role of a standard, i.e. the reference in replacing old means of labor with new ones.

The existence of a standard does not mean that all machines of this type that have outlived a given life need to be replaced with new ones. Individual machines can efficiently operate outside the limits of this life, whereas

some can be replaced long before its expiration. While being the same for all equipment of a given type, the standard service life should not play the role of a mandatory and rigid regulator of its actual retirement.

In practice, when determining equipment replacement time, one often limits oneself to comparing the actual and the standard service life. This approach does not ensure optimization of service life of equipment at each workstation. In order to more accurately determine the optimum moment for replacing equipment, a methodology is needed that is based on main provisions of the Methodology for Determining Economic Efficiency of Utilization of New Technology, Inventions and Rationalization Proposals and on the Typical Methodology for Determining Economic Efficiency of Capital Investment.

The urgent need for a methodology for calculating the effect of equipment replacement becomes clear during workstation certification. It is during the certification that it is especially important to determine whether to replace a specific labor tool with a new one, to modernize it or to leave it alone. The lack of clear criteria in solving these problems results in lower efficiency of the entire job of workstation certification. We think that the methodology must be typical. The existing experience in the development and utilization of the methodology of calculating the efficiency of replacement of metal-cutting equipment and other methodologies facilitates the development of this one.

The typical methodology can be based on main principles, used in determining the efficiency of capital investment. Particularly, in determining the time of replacement old equipment with new, one can proceed from comparing annual savings, realized from the replacement, with the required capital investment. The latter is the sum of expenditures for purchasing and installation of new equipment, dismantling old equipment and the cost of new production area, less salvage value of old equipment and savings of production area.

In calculating efficiency of replacing a pice of equipment, in practice one often compares only two options: to renew it at this moment in time or not to change at all. such formulation of the problem often leads to wrong conclusions and results in missing out on the potential efficiency of new equipment. Therefore, the approach, wherein various replacement versions are compared, is more justified. It is also feasible to take into account the fact that by merely comparing the versions, one cannot determine the optimum time for replacing old equipment with new. The integrated character of modern production manifests itself, among other factors, in the fact that each individual labor tool is not an independent production entity anymore, as it becomes an element of a system of machines, connected with other elements via a common production process. Therefore, in determining the time for equipment replacement, the factor of novelty and the progressive character of a production process the equipment is a part of becomes ever more important.

In order to accelerate renewal of production facilities, one should plan capital investment, construction, repair and retirement of means of labor in their entirety. In order to do this, one should broaden the use of standards for renewal of production facilities, particularly the optimum service life of various types of equipment and the standard ratio of fixed assets retirement.

Mean optimum service life must become a regulator of equipment production volume. It is important not to make more or fewer machines of any type. Deviations from necessary production volumes result in national economy losses. Industry retooling plans should be based on equipment balances, and in compiling the latter one must know the optimum service life.

During the current Five-Year Plan, the scope of retirement will double. The annual rate of retirement of fixed production assets will be at least 5-6 percent, 6-8 percent in the machine building industry. At present, the increased rate of retirement produces considerable economic and social savings. In the coming years, it must provide rapid replacement of worn-out equipment. However, as obsolete assets are retired, the problem of the optimum rate of retirement that would ensure permanent correspondence between the actual and optimum service life of means of labor becomes ever more urgent.

Under current conditions, a number of factors reduce mean optimum service life of assets. Obsolescence results in ever faster replacement of old means of labor. Changes in the composition of fixed assets also considerably affect their mean service life. When the share of active assets increases and that of plant decreases, the overall reproduction time of all assets decreases, even if the service life does not change. Calculations demonstrate that the decrease of the share of plant by 6-8 percent results in a one year reduction of mean service life of all assets. At the same time, the share of plant in the total amount of fixed production assets between 1960 and 1985 decreased from 61 to 47 percent, i.e. by 14 points.

Thus, both the increased obsolescence and changing composition of assets result in lower mean service life thereof, which in turn results in an increased retirement ratio. A slower growth of fixed assets also must result in an increased retirement ratio. Despite all this, the retirement ratio had been decreasing during the last 3 years of the Five-Year Plan. This trend has substantially weakened the technical level of the industrial potential of our country. It is because of this fact that it is planned to sharply increase asset retirement during the current Five-Year Plan. This pertains to their active part in the

first place. The annual retirement ratio of the active part of fixed assets in 1990 must be equal to 6.2 percent in the national economy as a whole and 9.7 percent in the machine building industry. Due to accelerated replacement of inefficient equipment by progressive and efficient machines, it is planned to accelerate the renewal of production facilities.

Accelerated retirement of fixed assets at a virtually unchanged rate of their growth is only possible in the case of correspondingly accelerated manufacturing of products of the machine building industry. Calculations demonstrate that a 43 percent increase in the production volume of the machine building industry, planned for the current Five-Year Plan, makes it possible to double the rate of retirement of the active part of fixed assets. It is especially important to ensure the correspondence between the planned retirement and the material resources that support the replenishment of retired means of labor in each industry and at each enterprise.

In order to meet the targets, stated by the Party, in accelerating the renewal of country's production facilities, it is necessary to change the procedure for planning production renewal. It is feasible to pay attention to problems of determining public demand for retiring obsolete means of labor and, in order to do this, determine in each industry (by the type of assets) the standard retirement ratio and take it into account when compiling the plan of industry retooling. It is feasible to plan the renewal ratio and the asset retirement ratio at the industry and subindustry level, introducing at the same time an index of cost of retired production assets at existing enterprises. At the enterprise level, this can be a calculated index, planned on the basis of retooling plans.

The use of such index as growth of capacity due to retooling and reconstruction virtually results in substituting enterprise expansion for reconstruction. As a result, investment, aimed only at improving production efficiency without expansion, is discouraged, and the requirement of continuous production growth holds back the process of replacing obsolete equipment at enterprises.

The new objectives of developing the Soviet economy call for new approaches to solving the problems of optimizing the service life of means of labor and for new methods for production renewal. Implementation of the optimum service life of equipment in the socialist business practice is one of the most important conditions for optimizing the entire production process.

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Technical Re-equipment and Reconstruction Surveyed

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[Article by A. Tsygichko, sector chief, NIEI [Scientific Institute for Planning Research] USSR Gosplan, doctor of economics: "Problems in Technical Reequipment and Reconstruction of Machine Building Enterprises"]

[Text] **Ways of increasing the level of modernization of fixed productive capital * Relationship between technical reequipment and reconstruction * Planning and designing enterprise modernization * Planning the removal of obsolete means of labor.**

Further progress in industry depends upon the reequipment of labor with new progressive technology. The orientation towards increasing the number of workplaces and towards attracting a larger workforce is no longer the correct way of defining factors in increasing economic growth. In order to operate under conditions of intensification the situation must to a great extent be studied anew, as past experience is not quite sufficient.

It is important to keep in mind that all types of major construction are now being transformed into specific forms of technical reequipment of production. This means a new view towards the general economic role of measures to withdraw obsolete equipment and free working hands, as well as material, energy and financial resources for progressive new technology and new production capacity.

The acceleration of enterprises' technical reequipment means that each new million rubles in capital investments will result in additional requirements for the liquidation (in a definite qualitative proportion) of equipment which has outlived its time.

A study of past tendencies in the expanded reproduction of fixed productive capital shows that in recent five-year plans the retirement rates for machinery, equipment, buildings and facilities were very low and did not correspond to constraints in the increase in labor power. The liquidation rates for old equipment have slowed down. Especially vivid evidence of this is shown by the lack of linkage between renovation policies and the changing ratio between the growth in labor and investment resources. Thus, in machine building and metalworking in recent years the retirement of fixed capital has only averaged a little more than 1 percent, while equipment retirement has averaged about 2 percent. In physical terms, the turnover of fixed capital declined. During 1976-1980, its conditional-actual service life exceeded 20 years, while in the 11th Five-Year Plan it was 3-4 years longer. For equipment this indicator increased by 2 years, reaching almost 20 years.

The 27th CPSU Congress stressed the need to decisively activate the renovation process, expecially in machine building, where the speed with which machine tools are replaced should increase almost fourfold. In preparing for this move, there must be a more attentive study of changes in the modernization of machine building operations.

Viewed against a general decline in the retirement rates for obsolete fixed capital, during the 10th and 11th Five-Year Plans there was an unexpected flurry of activity in enterprise technical reequipment. **Over the two five-year plans, the modernization of machine building and metalworking fixed productive capital through the introduction of new equipment during technical reequipment more than doubled. At the same time, in terms of reconstruction this indicator declined by more than a factor of 10.** While in 1976 expenses for it were one-fourth higher than expenses for technical reequipment, they have now become almost 20 times less. The replacement of means of labor is taking place almost through technical reequipment alone. This is shown, for example, by a comparison of the technological structure of fixed capital which has been retired and capital investments in machine building and metalworking. By the end of the 11th Five-Year Plan the retirement of machinery and equipment was more than 11 times higher than that of buildings and facilities. Expenses for equipment and capital investments exceeded expenses for construction-installation work by an even greater amount. The similarity of the structures examined contrasts with the technological structure of capital investments for reconstruction, in which the percentage of expenses for construction- installation work in the 11th Five-Year Plan was more than half of the total volume, that is, it was higher even than that same percentage during expansion and new construction. It follows that if equipment is retired during enterprise reconstruction, it is only in small amounts.

If reconstruction were accompanied by the large scale retirement of fixed capital, then the technological structure of retirement and the capital investment structure would not differ so noticeably.

Expenses during technical reequipment involve mainly the replacement of equipment and not passive components of fixed capital. At present this defines the main technological structure of equipment retirement. During reconstruction, when it is actually carried out through the perestroyka of operating enterprises, the share of construction- installation work is usually substantially higher than during technical reequipment, although it is somewhat lower than during expansion and new construction. Therefore, if there is any form of reconstruction, and not expansion and new construction in the guise of the latter, this would somewhat increase the retirement of buildings and facilities as a share of fixed capital retirement. We note, for example, that at the end of the 11th Five-Year Plan expenses for technical reequipment were three times higher than the retirement of fixed capital in machine building and metalworking. This proportion is probably close to the average ratio between the cost of new equipment and the old it replaces, although it could possibly be somewhat higher. Expenses for equipment were three times higher than retirement.

In 1976, expenses for technical reequipment were a little less than one and a half times higher than the retirement of fixed capital in machine building and metalworking. From this it is clear that there was previously a very much closer linkage between retirement during reconstruction and the liquidation of entire capacities.

What has caused the sudden quickening of technical reequipment at operating enterprises? One can make several judgements, based upon information about the renovation process.

To begin with, every enterprise (including machine building), once it is started, has various reserves for developing its technical base, improving manufacturing processes, improving the utilization of the initially installed equipment and for increasing capacity without changing production areas or stopping production. Additional capital investments for the replacement of individual machines and entire systems, for mechanization, automation and other measures included in the list of technical reequipment work at operating units can be relatively small, but very effective.

However, one cannot expect this to be continued endlessly. As the years go by the initial technological principles become obsolete, the possibilities for installing new equipment become limited, while buildings, facilities and utilities wear out and cease to be appropriate to working conditions, production intensity and volume. **An enterprise cannot remain permanently young through technical reequipment. The time comes when, after stopping the enterprise, it is necessary to thoroughly restructure it or close it in order to more rationally use capital investments, above all for reconstruction.**

Of course, the potential for periodically improving enterprise efficiency depends upon manufacturing process and design flexibility and on previously recognized reserves. The efficiency of expenses for these purposes can be estimated on the basis of savings from repeated modernization of production in the future and to earnings linked to the enterprise's capability for quickly using technical innovations and quickly reacting to changes in demand for its products.

At present, technical developments in machine building are mainly oriented towards the creation of flexible equipment and manufacturing processes, flexible automation systems and machining centers and towards facilitating perestroyka in the passive components of fixed capital. This will permit the more rapid mastery of new and improved products, and improve the parameters and economy of production processes.

However, even with the technological principles now mastered, there is a limit to improvements in each specific type of machine system in an enterprise, especially as new equipment and techniques appear. This is all the more irreversible for enterprises which are 40-50 and more years old. **There are many old enterprises and units requiring radical reconstruction or closing. Meanwhile, reconstruction, especially radical reconstruction, has been curtailed.** This is shown by the large unused possibilities for developing production operations and the big benefits from outlays for the technical reequipment of enterprises. In any case, **in the 10th and 11th Five-Year Plans the rapid growth in fixed capital modernization through technical reequipment did not improve the dynamics of machine building efficiency indicators,** nor did it retard the drop in output-capital ratios and the marginal efficiency of capital investments or improve indicators for the use of raw and other materials. There is no direct evidence of the high general efficiency of expenses for technical reequipment, on the contrary, it shows the opposite. For example, a comparison of the planned efficiency of these expenses (for increased machine building) with the efficiency of expenses for reconstruction in accordance with 1981-1984 planning-design data for enterprises has shown that that only in Minstankoprom [Ministry of the Machine Tool and Tool Building Industry] is reequipment more effective than reconstruction. In the following ministries reconstruction turned out to be more effective than technical reequipment: Mintyazhmash [Ministry of Heavy and Transport Machine Building], Minelektrotekhprom [Ministry of the Electrical Equipment Industry], Minkhimmash [Ministry of Chemical and Petroleum Machine Building], Minselkhozmash [Ministry of Tractor and Agricultural Machinery Building] and Minstroydormash [Ministry of Construction, Road and Municipal Machine Building]. There are no comparative data for other machine building ministries. However, the information available shows that efficiency considerations were not decisive in answering the question in favor of technical modernization.

In order to find the reasons technical reequipment is preferred, it is necessary to reveal the factors constraining reconstruction and excluding it from capital construction at operating enterprises.

Reconstruction generally has two interrelated forms. First, through the perestroyka of operating units, shops and installations; and second, through the creation of new capacity while the old capacity which could not be rationally restructured is closed down. The conditions for expanded reproduction of fixed capital which have existed up to now have more often promoted the curtailment rather than the development of the first form of reconstruction.

First of all, we note that the dissipation of capital investments, the extension of construction times and the scattering of resources causes construction organizations to primarily build new enterprises and projects. They thus avoid individual, unique reconstruction work, complicated by ongoing production operations.

It is also easier for design organizations to deal with standardized new construction than with the modernization of enterprises built long ago and which requires special design solutions. Deprived of support from this side, enterprises, associations or ministries are also not inclined to change the situation. They are prevailed upon to restructure production without stopping it. This is prolonged and not compatible with thorough reconstruction. At present construction rates, this latter might mean stopping the entire enterprise or part of it for many years, not a very enticing prospect for managers. As a result, instead of concentrating capital investments on a limited number of large units intended for radical reconstruction, resources are in the end scattered among many enterprises for small scale technical reequipment by the enterprises themselves, while production continues.

It is difficult to calculate the efficiency of such scattered outlays. This is all the more so because a sizable amount of technical reequipment uses resources allocated for major repairs. These also cannot be very effective, not only due to their small size, but also because sometimes new equipment is put into old manufacuring processes and production infrastructure and therefore does not yield the needed effect, although it can be arbitrarily credited with high returns.

The second form, reconstruction, which, judging by the technological structure of capital investments has become predominant, has also had difficulties in the last two five-year plans, as strict limitations have been introduced on the liquidation of production capacity at enterprises and other units.

Designs and plans for reconstruction frequently make provisions for retiring sizable amounts of obsolete fixed capital after the creation of new. However, as has been shown, reconstruction is almost never accompanied by the removal of equipment from operation. The probable reason for this is that because of the prolonged construction of new projects (due to the scattering of capital investments) and the sizable divergence of actual and normative construction times the old units continue to function longer than intended. Obsolete but operating units naturally require modernization because of changing output and the need to improve production efficiency as wages and material incentives funds for collectives depend upon it. This delays even more the creation of new units to replace old ones because it deprives them of part of the capital investments. Moreover, the modernization of obsolete shops hinders making decisions about closing them or introducing new projects. Generally, this requires special authorization, which is not taken into account by design decisions and plan calculations. As a result, practical experience shows that new projects and capacities are being introduced at the same time old ones are being maintained for long periods and modernized.

Probably, this can primarily be explained by the growth in fixed productive capital during reconstruction considerably exceeding the planned magnitude, rather than by the introduction of new fixed capital during expansion and new construction. Thus in 1985, according to sample surveys at 11 machine building ministries, the increase in fixed capital at enterprises and projects reconstructed during 1981-1985 was more than one-fourth higher than the planned figure. The cost of new enterprises and projects, although it exceeded the planned level, was seven times less than for reconstruction.

The enterprises themselves are in no hurry to liquidate old fixed capital assets, especially because they help retain scarce labor power. Sometimes there are more workers assigned to old production facilities than to new ones. Also, the presence of obsolete capacity and jobs makes it possible to work mostly one shift. This is also an attractive social factor for some workers. However, these old facilities are far more expensive to modernize and repair, even just to maintain present capacity. Also, new projects and capacities created during reconstruction do not obtain sufficient labor, material and energy supplies. Studies based upon sample surveys show that they do not reach planned efficiency indicators. At times they experience even greater labor shortages than for expansion and new construction. Reconstruction initially intended as a means of newly reequiping labor often assumes the shape of expansion and even new construction because old fixed capital assets are retained which simultaneously increase the demand for additional and inefficient technical reequipment.

The conversion of industrial enterprises to full cost accounting [khozyaystvennyy raschet] is still not solving contradictions in the renovation process. Also, the setting up of untouchable reserve funds at enterprises for production development, science and technology is another hindrance to the concentration of resources on large reconstruction work and does not make it easier to close obsolete capacity. The expansion of enterprises' rights in technical reequipment and reconstruction is not accompanied by a softening of constraints on shutting down or closing capacity. Therefore, enterprises actually are still largely left with the choice between technical reequipment and expansion, avoiding serious reconstruction, even if it will increase funds for the development of production, science and technology.

For the conversion to full cost accounting to fully promote improvements in economic efficiency it is necessary to simultaneously **improve the centralized planning of the withdrawal of obsolete equipment, which will guarantee the reequipment of production on the socially necessary scale. This requirement should be determined in a national economic plan for the withdrawal of obsolete capital assets based upon general economic investment possibilities (centralized and noncentralized) in the new equipment's technical standards, taking into account the possibilities for cadre job creation through new construction.** The withdrawal of machinery, equipment, buildings and installations must be separately linked to technical reequipment, reconstruction and radical reconstruction where production is stopped, expansion and new construction supporting capacity and its closedown as a form of reequipping labor on a new technical basis and with enterprises' conversion to 2 and 3 shift work. Such withdrawal, freeing labor, material, energy and financial resources and production area for the newest equipment can be planned as the final liquidation of passive and active components of fixed productive assets both reproducible and nonreproducible in the old place. This is through their transfer, leading to their long term elimination from economic circulation, for example in connection with their centralized modernization or use in expansion and new construction; in the form of functional retirement, when there are enforced time constraints and changes in the character of their operation; and in the form of conserving production capacity or creating capacity reserves. It is important to take into account the prevention of production losses at the result of retirement optimization.

Based on a national economic plan, it is necessary to coordinate, with enterprises and ministries, the approved withdrawal of fixed productive assets. The plan will create the legal basis for the renovation process, make possible the proper balancing of measures for perestroyka of existing production (with or without stopping production), legalize the closing of capacity and enterprises when necessary and economically expedient and free equipment for conversion to 2 and 3 shift work. It will help coordinate the program for increasing and modernizing output and for meeting contractual obligations for delivering output with tasks in the reequipment of labor on a new technical basis and with occupational retraining.

Ministries have now been given specific targets for accelerating the retirement of fixed productive capital and have been outlined tasks for reducing excess jobs and the amount of freed equipment by value and number in connection with the conversion to 2 and 3 shift work. However, this is still not a plan for comprehensive retirement or for the withdrawal of obsolete equipment. Without the coordination of such targets with all other plan parameters, with the peculiar nature of developing the enterprises' economic independence and with the general relationship between labor and investment, it is possible to have justifiable lagging behind intended goals and to retain the tendency for jobs to increase faster than the number of workers. **A study of 1987-1990 retirement targets shows that among machine building ministries only Minavtoprom [Ministry of the Automotive Industry] has outlined the retirement of fixed productive capital which will be enough, if it is attained, to indisputably assure it balanced growth in fixed productive capital and labor power.** Retirement is increasing in other ministries but not enough to guarantee that the increase in the

number of excess jobs will be curtailed. As a result, even the newest capacity can experience shortages of labor and other production resources.

A national economic plan for withdrawing obsolete fixed capital from production will not only support all conditions for accelerating the renovation process at the socially necessary scales, but also solve its contradictions correctly combine all forms for reequipping labor on a new technical basis, and take into account the possibilities for meeting normative construction times. This will lead to the development of radical reconstruction with production halted as an important form for replacing obsolete equipment. This is made easier by sizable reserves of unused capacity.

The introduction of new capacity must be accompanied by the closing of the old if this was foreseen by the reconstruction plan and the withdrawal plan. This will make it possible to reduce the accumulation of capacity which has outlived its service life, the functioning of which unavoidably requires major repairs and modernization.

The realization of withdrawal plans should be based upon appropriately organized control over accelerating the renovation process, taking into account the need to coordinate the interests of various enterprises, ministries and local organizations which might conflict during the large scale liquidation of productive capacity and the related need to partially redistribute labor, material, energy and financial resources.

It is also advisable to direct attention to specific features of the renovation process in machine building. In this sector there are objective requirements not only to accelerate the replacement of old equipment with new, but to substantially reduce the entire stock of metalworking equipment. This will make it possible to get rid of inefficient enterprises and projects, to free production areas from inoperative, obsolescent and obsolete equipment, to use such areas for production at higher levels of mechanization and automation and to better provide key personnel with more productive machine tools, especially replacement ones.

Machine building is to revolutionize its technical base and simultaneously prepare for technical changes in other sectors. Moreover, this must be done rapidly and with the personnel now available. To facilitate solutions to this task, space should be given to all forms of technical reequipment, and their coordination within the framework of a plan for withdrawing obsolete equipment. This plan's development should begin with a determination of control figures for retiring fixed productive capital.

Very useful here is information available at the beginning of the plan period, in particular on the breakdown of equipment by age groups (up to 5 years, 5-10, 10-20, and older) and on the technical condition of the machine stock. It is important to know about staffing and redundant jobs. There can be a more confident justification for accelerated retirement where equipment is clearly obsolete, a large share of it has outlived its normative service life, sizable amounts are subject to replacement because they are obsolescent or obsolete and there are large numbers of redundant jobs and much unused equipment. We note that there is basis for this reproduction policy in all machine building ministries. Also, the sooner there are data on entire manufacturing processes becoming obsolete, the sooner one can get an idea about the need for radical perestroyka or closing down of capacity because it does not meet contemporary technical standards. With the help of the information mentioned one can first estimate how much obsolete equipment should be retired so as to better use previously introduced technically progressive fixed capital, taking into account the social-economic prerequisites for further increases in enterprises' shift coefficients. This is based mainly upon data on the number and cost of redundant jobs. However, this is not enough. It is also important to know the amount of retirement required to attain the needed staffing in the plan period

The preliminary estimation of fixed capital retirement during the plan period requires not only data on equipment age and technical standards, but also information on the full balance-sheet value of fixed capital at the beginning of the period, on the introduction of new capital assets and the number employed at the period's beginning and end, data on the average capital-labor ratio at new enterprises and projects, on new jobs and the growth rate of this capital-labor ratio compared to the average base figure.

Calculations should show at what retirement volumes all equipment will be supplied with workers at the base level. Naturally, not all jobs which can be created during new construction and expansion can be supplied with workers only through natural increases. Therefore, some of the old equipment must be liquidated in order to free workers for new jobs, while some of the new fixed capital should replace old equipment during the technical reequipment and reconstruction of operating enterprises.

In conclusion we note that the compilation of control figures for the retirement of fixed productive capital will help plan organs in posing first-approximation assignments for accelerating the replacement of obsolete equipment in sectors. This will be refined during the preparation of a coordinated plan for withdrawing it from operation. This plan will specify ways to accelerate technical reequipment in all possible forms, and to improve the use of the newest equipment and modern capacity. Data on the age and technical condition of equipment and techniques indicates that **the prerequisites are present to substantially expand reconstruction work where production is halted and to close down obsolete capacity. If this is not covered in plans for the withdrawal of obsolescent and obsolete equipment and if there are no provisions for the other prerequisites to this**

acceleration of the renovation process, then it is difficult to hope for reductions in the burden of especially old fixed capital and techniques. It is clearly insuffcent to reduce the matter to the creation of favorable conditions and stimuli only for technical reequipment.

11574

Machine Tool Industry Tasks, Improved Output Discussed

18610008 Kiev RABOCHAYA GAZETA in Russian 14 Aug 87 p 3

[Article by RATAU [Ukrainian Telegraph Agency] under the subtitle "More Rapid Development of Machine Building"]

[Text] Machine tool builders face responsible tasks in the current five-year plan: by 1990 they must triple the acceleration of development and introduction of new types of equipment, bring 80-95 percent of output up to world standards and increase the productivity of newly created equipment by a factor of 1.5 to 2.

The fulfillment of party and government decrees on accelerating the development of new high quality equipment and organizing its series production at machine building enterprises in the republic was examined at a Ukrainian Communist Party Central Committee meeting held on 12 Aug 87. The managers of machine tool building production associations and plants, special design offices, secretaries of party committees and buros and managers of gospriyemka [state acceptance] at enterprises all participated in the meeting.

As was noted at the meeting, there have been some positive advances in machine tool builders' work since the start of the current five-year plan. There have been improvements in the structure of machine tool technology, increases in the proportion of specialized and multifunction equipment, and the production of numerically controlled machine tools, machining centers and flexible production has increased at pace-setting rates.

Participants at the meeting focused attention on unsolved problems. In their presentations they expressed particular concern about design offices' unsatisfactory work on creating new equipment. Often developments are oriented towards a 3-5 year horizon. The cycle from the beginning of development to series production is slowly shrinking. As in past years, it remains at about 5 years. It still takes an extremely long time prepare new equipment for series production.

State acceptance specialists discovered major shortcomings at enterprises. Today a little more than 70 percent of output passes upon first inspection. The situation is unsatisfactory at these plants: the Kharkov Machine Tool Building Plant, the Odesssa Radial Drill Plant, the Kommunar Plant in Lubensk and the Zhitomir Automatic Machine Tool Plant.

Participants at the meeting were self-critical, gave a businesslike analysis of the reasons for lagging in completing plans and targets and outlined ways of improving technical standards for output and for increasing the manufacture of modern production equipment.

The following participated in discussions: S. I. Gurenko, candidate member of the Politburo and secretary of the Ukrainian Communist Party Central Committee, V. M. Gayev, chief of the Ukrainian Communist Party Central Committee's Machine Tool Building Department, V. G. Skryabin, deputy minister of the USSR Machine Tool and Instrument Building Industry, and responsible workers from the republic's Gosplan and Gosstandart [State Committee for Standards] agencies.

11574

Structural-Organizational Prospects for Developing Machine Building's Production Potential

18610008 Moscow VESTNIK MASHINOSTROYENIYA in Russian No 9, Sep 87 pp 67-69

[Article by O.A. Zverev, candidate of economic sciences]

[Text] Between 1960 and 1985 fixed productive capital in the USSR increased 7-fold and exceeded 1.5 trillion rubles, 44 percent of total national wealth. Together with quantitative growth there must also be qualitative renewal of the production apparatus, primarily through the more rapid replacement of inefficient equipment with progressive, highly productive units.

A basic contribution to forming the active component of production potential is made by machine building, the development levels of which are important in solving one of the main socialist tasks—reducing the percentage of manual labor, especially in auxiliary and service operations.

The contemporary stage of scientific-technical progress is newly posing questions in forming the technical and structural-organizational basis for machine building. This is linked to the need to create resource conserving equipment and to sharply increase the assortment of equipment produced. These are possible only by increasing the division of labor and developing specialization by part and process.

During the long period of time in which physical increases in production were the basis for development, improvements in structural policies were delayed for several reasons.

One of these reasons is that during extensive growth in production potential there is no interest in qualitative changes in structural potential. In the opposite case, improvements in production structure inevitably lead to declines in production volume, especially in intermediate stages, where traditional raw and other materials are replaced. For example, the replacement of steel gasoline tanks in motor vehicles by high density polyethelene tanks makes possible a three fold savings of metal. Also, each ton of chemical materials requires 4251 R fewer capital outlays and 118 man-hours less labor. Production costs decline by 244 R. When one considers that behind each of these figures stands the interests of several sectors whose production- economic activities will decline as a result of these replacements, then it becomes understandable why progressive design materials are being so slowly introduced.

From the perspective of improved efficiency the national economy as a whole and each individual enterprise have one goal—maximizing the return from all installed equipment. However, from the perspective of final results there are contradictions between national economic and cost accounting [khozraschet] interests. These are deepened by the imperfections in the system of evaluation indicators. If society is interested mainly in increasing the final results from using the means of production, then the enterprises' tasks boil down a policy of setting up equipment so that the output of already-established products will not be decreased.

This contradiction inevitably leads to attempts to obtain more resources for equipment repair and not for its replacement and to reductions in the pace of renewal of fixed capital at industrial enterprises. NC machine tools and robot components often work beside 30-40 year old machine tools, which are obsolete and require expensive repairs. This multi-model machine stock increases service costs.

The annual average retirement of obsolescent and obsolete equipment did not exceed 1.3 to 2 percent between 1980 and 1985. The following data show the growing difference between the introduction and the retirement of fixed productive capital [Footnote 1. Calculated from the data of the statistical annual report "Narodnoye Khozyaystvo SSSR v 1985" [National Economy of the USSR 1985], Moscow, Finansy i statistika, 1986]:

Year	1971-1975	1975-1980	1980-1985
Introduction as percent of stock's value at end of period	46	42	37
Retirement as percent of stock's value at beginning of period	11	8	4.5
Excess of introduction over retirement (by a factor of...)	4.2	5.2	8

In several sectors the equipment age structure is increasing. In the electrical equipment industry 41.5 percent of the machine tool stock has been operating more than 10 years. This also includes 10.9 percent which has been working more than 20 years.

In recent years the increased share of obsolete equipment has reduced the output-capital ratio and profitability of fixed productive capital in machine building (from 16.6 percent in 1975 to 12.2 percent in 1984). A small part of the reduction in the equipment use indicator is due to the low level of specialization. A USSR Academy of Sciences' Economics Institute study of 29 sectors in machine building shows that at specialized plants labor productivity and the output-capital ratio are 20 and 25 percent higher than at plants in consuming sectors.

The need to retain or slightly increase the volume of present production assortment required ever increasing expenses not for the expanded reproduction of fixed capital, but for its replacement. This prevented the redistribution of resources for improvements in production structure and for the development of specialized production operations. At the same time, qualitative perestroyka of fixed capital linked to its accelerated renewal (4-6 percent annually) would require capital outlays 1.5 to 2 times smaller than resources from the depreciation fund for replacement and rennovation [Footnote 2: According to Ye. Pavlova (PRAVDA 2 Nov 84), only 7 percent of capital investments and 1.9 percent of machine building output].

In the late 1970s and early 1980s a deep intrasectoral change began in machine building. This was linked to the introduction of fundamentally new types of equipment and techniques. An ever greater share in the fixed capital structure is held by multisectoral equipment: monitoring- measuring devices, intraplant transport equipment and computers. However, if the development of such technology moves along existing forms of specialization it will lead to a hypertrophic increase in the production of intermediate products for machine building (billets, parts and fittings). Already output for general sector use makes up 25 percent of the total.

In closed production cycles, where all auxiliary and service processes are within a single enterprise, considerable disproportions in production capacity arise. Under such conditions it is difficult to introduce fundamentally new technology, as its installation in one component of multistage production immediately imbalances the enterprise as a whole. In addition the fundamentally new equipment installed is not used to full capacity. Frequently, high quality lathes or NC machine tools are only 15-20 percent used.

A low level of part specialization delays the development of object specialization. A direct dependence can be traced here: the number of assembly shops and plants can increase if there is a constantly growing volume of deliveries of semi-finished parts and assemblies, but this

cannot be assured in a closed production cycle. In several instances enterprises have had to produce some scarce parts on their own. This can be seen in output for general machine building use. Twenty-two plants of the Ministry of Heavy and Transport Machine Building produce only 17 percent of the equipment for underground transportation, the remaining 83 percent is manufactured at 400 plants in 35 ministries.

During 1986-1990 it is intended to renew fixed capital, primarily through the more rapid replacement of inefficient equipment by progressive, highly productive units. It will be necessary to renew more than half the active component of fixed productive capital and to have at least a three-fold increase in the renewal of obsolete capital assets. The fixed capital renewal policy should be based upon the transition from replacing individual machines and equipment to comprehensive systems of machinery and manufacturing processes encompassing entire blocks of functioning subsystems in the production process as a whole and in auxiliary production. In sets of machinery there is a sharp increase in the potential for combining general purpose and special machines. This is because machine systems lead to the conversion from mixed use to part specialization, based upon standardized components.

The optimal combination of all forms of specialization makes it possible for enterprises specializing in final output to concentrate attention on scientific and technical preparations for production, time-and-motion study of assembly processes, and fuller study of market demand and expansion of the sphere of machine services.

Together with the development of progressive forms of specialization (by part, component and technological process), in the long run another form will be developed—modular—based upon the aggregate and block construction of technical systems. This is additional support for V. I. Lenin's conclusion that the specialization of social labor is "...in its very essence infinite, like technological development".[Footnote 3: V. I. Lenin, "Polnoye sobraniye sochineniy" Vol 1 p 95]

Modular specialization objectively reflects the aspirations of production to meet the customer's needs as closely as possible and to steadily increase the number of modules, types and sizes in machine building. Individual modules can be combined into machines with various functions. In essence, the standardization of technical modules will become the basis for all equipment in multisectoral use.

So far only the general outlines of modular specialization in machine building have been sketched. Within the framework of the Comprehensive Program for Scientific-Technical Progress in CEMA Nations Up Until the Year 2000, the ENIMS Scientific Production Organization in Moscow has begun working out a unified technical policy for metal cutting equipment based upon extensive standardization and unification. An example of this policy is the use of Bulgarian cylindrical grinding machines to create flexible production systems. The mastery of the production of standard-unit type machine tools at the Machine Building Plant imeni S. Ordzhonikidze is another example.

Modular specialization can be deepened not only through expanded functions for machines and transfer mechanisms, but also can be based upon new modules performing control functions. The basic elements in control modules are electronic circuits which can be used in different equipment and instruments.

However, modular specialization can be highly efficient only if unified components are widely used. One of production's main contradictions is between the producer's interest to increase production runs and the need to be more oriented towards continually changing demand and techno- economic requirements made upon machines. Statistics show that the bigger the production run the higher the specialization levels. They are the longest in mass production. However, another problem arises here—rapid retooling. At present about 60 percent of automatic and mechanized flow lines in mass production are oriented towards doing a single project.

Enterprises with small and medium production runs are among the least specialized (incidental production exceeds 30 percent). These account for 75-80 percent of all metalworking enterprises and the product mix is characterized by a significant amount of variation. Only an insignificant number of these enterprises are oriented toward producing unified products suitable for a wide range of equipment. This makes necessary increases in machine building modules, types and sizes and reductions in production runs for various components and parts.

In the immediate future each machine building sector must convert to producing parametric series of machines, making use of unified components and parts based upon several standard models. An example of this is nature itself, where the vast diversity of forms in living and nonliving matter is created from a small number of basic elements. Of great interest in this regard is the experience at the Krasniy Proletariat Machine Building Production Association in Moscow. This association has created a family of machine tools intended for various types of operations and working conditions. This family includes more than 40 modifications, each modification using 426-460 parts from the base model. As a result, the unification level is 90 percent.

Modular specialization, based upon optimal technological and part specialization helps enterprises select the optimal machines. By linking individual technical and

production components into systems supplemented by comprehensive services, a new type of highly productive production section distingushed by low capital intensiveness can be created.

Having a diverse assortment of modular machine tools with many series produced components, flexible automation can be approached. The main advantages of flexible systems are: a sharp reduction in the length of the production cycle, a larger assortment of final products, increases in equipment capacity, reductions in expenditures on personnel, less time needed to prepare production for different products, and less area needed for equipment and supplies. Flexible manufacturing systems can also include machining centers, NC machine tools, robots, automated transport systems for delivering materials and parts to machine tools, ASUP [Automated production control systems] and microcomputers. With their introduction, labor productivity can be expected to increase 3-4 fold and product quality to improve.

The development of a new technical base for machine building inevitably requires improved organization for production and management. The negative experience at many enterprises of introducing NC machine tools and not changing their obsolete organization of the production procss has vividly demonstrated the damage this can cause to the national economy. Genuinely revolutionary technology sometimes requires fundamental decisions not only in organizing technical training, but in material-technical supply, payments and incentives to labor and even fundamentally new architectural-planning decisions in constructing and reconstructing shops. It is necessary to have comprehensive solutions to questions in specializing the creation, manufacture and introduction of progressive equipment and flexible manufacturing and in supplying tools and fittings. Only then will it be possible to solve key tasks in bringing machine building to the most progressive frontiers of science and technology.

11574

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Non-Refrigerated Infrared-Radiation Receiver Based on Thermoelastic Effect in Crystalline Quartz

18610201b Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30, No 9, Sep 87 (manuscript received 17 Dec 86) pp 89-94

[Article by G.G. Ishanin, G.V. Polshchikov, S.S. Przhevskiy, S.P. Fetisov, and V.A. Yakovlev, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] The theoretically established feasibility of a non-refrigerated crystalline quartz thermoelastic infrared-radiation receiver, for use as energy converter in the photometry of industrial lasers, was verified experimentally. Ten were studies at VNIIOFI [All-Union Scientific Research Institute of Optophysical Measurements] and 20 specimens at LITMO [Leningrad Institute of Precision Mechanics and Optics]. The test stands included in ILGN-705 or ILGN-104 laser (10,600 nm wavelength) and an LG-78 probing laser, a beam-splitter, mirror and lens optics, an OSI-SM master power meter, and an IMO-2N average power meter with an attenuator. Measurements were made by the matching method, the main object being to determine the spectral sensitivity characteristic and the current-voltage characteristic of such a receiver. The results confirm its suitability for the given application and indicate a long stability of its conversion efficiency. The article was presented by the Department of Optoelectronic Devices. Figures 5; references: 4 Russian.

2415/12913

Assembly Automation and Flexible Systems Development Concepts

81444567 Moscow TRAKTORY I SELKHOZMASHINY in Russian No 5, May 87 pp 43-47

[Article by V. K. Zamyatin, candidate of technical sciences and chairman, "Machine-Building Assembly and Installation" section of the TsP NTO Mashprom (central board, Scientific-Technical Society for Machine Building) under the heading "Technology, Organization and Economy of Production"]

[Text] Assembly is the concluding and most important stage of production, where the basic indicators of product quality (reliability, operability, and so on) take shape. Assembly processes are characterized by the complex influence of interconnected design, technological and use factors determining item technical-economic indicators. Further, the influence of assembly on product quality increases as the class of the machinery and instruments being manufactured rises. Quality improvement depends on the level of assembly mechanization and automation, on monitoring all parameters of this process for which standards have been set: clearances, tensions, assembly force, torque settings for threaded parts, axis alignment, and so forth. But the level of assembly mechanization and automation is still low. At many enterprises, these operations are still done manually, using poorly qualified workers. Hence, a large part of the failures of machines is due to defects from poor-quality assembly.

Effective assembly is achieved through the extensive introduction of fundamentally new technologies based on the use of progressive, highly productive assembly methods and using computers to optimize technologies which ensuring continuous, automated assembly processes and production control.

At present, assembly production is the most promising area for reducing the material and human resources required, for reducing monotonous, physically difficult, manual labor in comparison with other process stages.

Assembly processes are currently a disproportionately high percentage of total machinery production labor intensiveness (25-40 percent). In a majority of cases, the labor intensiveness of these jobs ordinarily approximates (or exceeds) metal-cutting operations and considerably exceeds all other technological stages of production in terms of labor expenditures. Further, an analysis of the reduction in labor intensiveness by job type shows the following: the relative labor intensiveness of blank-working (casting, forge-press and welding work) and metal-cutting processes has been decreasing steadily, year by year, due to the introduction of mechanization and automation equipment, while the relative labor intensiveness of assembly has generally risen (or has remained unchanged), inasmuch as less mechanization and automation equipment is used in those jobs. The proportion of fixed assembly production assets in machine building is only 5-10 percent of all fixed production assets, which does not conform at all to the labor intensiveness of assembly processes. As a result, only 20-30 percent of all machine-building assembly operations have been mechanized and less than 6 percent have been automated.

This lag behind other types of production is to be explained not only by shortcomings in the work of individual organizations and ministries, but also by the fact that statewide concepts of optimum functioning and development of the assembly-production infrastructure were not worked out at the proper time. Assembly-process mechanization and automation work by the VUZ's and by the production, scientific and planning organizations of the various ministries has not been coordinated centrally and experience has not been shared.

Each branch of industry has solved both its general, interbranch assembly problems and its specific, branch assembly problems independently, meeting its own equipment and fixtures requirements. But that has, in turn, led to primitive production, to parallelism in the development of standard technical documentation and in the release of standard assembly mechanization and automation equipment. Hence, increased time involved in the technological preparation of production, the consequence being that the national economy receives obsolescent assembly equipment.

The low level of development of assembly production also results from the unsatisfactory use of scientific and technical achievements, from the scarcity of highly skilled specialists, from the absence of centralized, planned leadership and supervisory coordinating organizations for assembly issues, from the lack of interbranch plants specialized to produce standard assembly-process mechanization and automation devices, and also from the lack of close cooperation among the subdivisions of the various ministries concerned with developing, manufacturing, introducing and exploiting assembly equipment.

The absence of generally accepted methods and standards for providing technological components with assembly items has led to a situation in which designers continue to create components which fail to meet the requirements of automated assembly production and thus create serious and often insurmountable obstacles to automation.

The most important area in which to increase assembly efficiency is the development of optimal, readjustable technological processes which ensure the assembly of items of different designs based on the principles of flexible readjustable technology incorporating robotized assembly complexes and computer-controlled flexible manufacturing system (FMS).

The great flexibility of an assembly FMS is achieved by raising the level of automation of the assembly-process control systems, as well as of the scientific research and design of the items being assembled, the technological preparation of assembly production, and programmability of the technology and of the component control elements of the entire process equipment complex, by implementing the modular principle of designing all component system elements, increasing its viability and speed of readjustment to switch over to assembling new items, by ensuring the organizational, equipment, program, mathematical, information and linguistic compatibility of all system components by type-size consistency, by standardizing, and unitizing the items being assembled and their component parts, by increasing the technological effectiveness of their components so as to automate assembly, by developing and using a scientifically substantiated system of classifying and grouping assembly items and their parts, by choosing an optimum composition and size of the process group for each assembly system, as well as by selecting and developing optimum readjustable assembly technological processes and by using efficient devices for and ways of controlling them, by using highly productive programmable and readjustable assembly equipment, systems for transporting, storing and warehousing, loading and unloading assembly items and using efficient systems for monitoring, diagnosing and servicing systems, computer equipment and programmed control, by selecting and developing an efficient structure and readjustment of flexible technological assembly processes, by reducing the time involved in readjusting system elements, by selecting the most efficient assembly sequence and conditions for the entire mix of items being released, by optimizing the size of the runs, by building microprocessors into process equipment and unifying all microprocessors and computers into a multilevel programmed-control system, by selecting an optimum assembly system variant.

In this regard, one needs a precisely organized product quality control system, but the present one is at an insufficiently high technical level. Often, for example, not all the parameters influencing item exploitation characteristics are monitored during assembly. Many subassemblies still do not undergo full bench testing. Assembly shops often lack (or have too few) quality control stations for recording all the parameters being monitored and then recording the results in the passport of each machine. Technical commissions which disassemble subassemblies, units or machines, inspect all their parts, connections and assembly parameters and record all deviations which must be corrected, have worked irregularly. All the enumerated measures must be strictly carried out. A unified system of metrological support for the technological processes of assembly based on world metrology and measuring-equipment achievements is therefore necessary.

In spite of the successes of a number of leading enterprises and organizations in the field of assembly mechanization and automation, the automated assembly equipment used in machine building is generally special-purpose. In a majority of cases, its use is economically inexpedient, even in mass production, due to the constant shortening of product-mix updating intervals and due to the complexity of the designs of the items being released. For example, tractor and agricultural machine building is to develop and put about 600 new and modernized pieces of equipment into production in the near future, and upwards of half of that will be produced in small lots. The basic direction of technical progress in assembly production must therefore be the development and extensive introduction of FMS which ensure rapid production reorganization to assemble new items with maximum retention of the equipment previously used, and that is possible given the extensive use of programmable and readjustable assembly equipment. It is important in this respect that the assembly equipment being developed be technologically compatible in the various branches of machine building.

The development of standard unitized modules such as the elements of loading devices and thread-cutting equipment, assembly chucks and pneumatic presses, nonsynchronous transport system subassemblies and technological transport modules for circular and linear arrangements, mills and stands is based on different scientific-methods principles and is done without proper scientific-technical substantiation in the different branches of industry. As a result, many of the existing modules do not meet the flexibility requirements of modern assembly production and are inferior to analogous developments by companies abroad in their technical-economic indicators (reliability, productivity, precision, dimension-weight characteristics, and so on).

Work on developing standard assembly-equipment modules is not centrally coordinated, although the assembly modules developed in one branch can be used in others as well, in many instances. Based on this, it is appropriate to create interbranch facilities to produce them. The centralized release of such modules would permit the design of new assembly equipment consisting of 80-90 percent purchased parts, subassemblies and modules. In this connection, the time and expense involved in designing, manufacturing and introducing the equipment could be cut several-fold. Development of the type-size range and products mix of such technological modules should be done on a unified scientific-methods base based on a structural-technological classification of the items being assembled with consideration of ensuring very flexible assembly production.

In order to increase the effectiveness of assembly production, the basic, auxiliary, transport, warehousing and freight-handling operations need to be fully mechanized and automated, making the assembly process as a whole continuous to the maximum degree. In other words, modern transport and assembly conveyors, including automatic-address ones, need to be introduced more widely, along with automated test and adjustment stands, hoists, loaders, cranes, tippers, automatic loading devices, washers and dryers, devices for warming and cooling parts, devices for packing and packaging parts, and robots and manipulators. However, the centralized production of this process equipment hardly exists (they are manufactured mainly by the plants themselves), leading to inefficient expenditures of labor and funds.

Industrial robots (PR) are an effective means of automating basic and auxiliary assembly operations and possess great flexibility. They can function autonomously or as components of assembly equipment.

PR are used most successfully in equipment loading operations, for interoperation transport of items being assembled, for the free positioning of parts in an item being assembled, and for making joint gaps. PR have thus far not been used extensively to automate basic assembly operations (tightening, squeezing, fitting, fastening, and others, especially when the connections are relatively large), due primarily to their inadequate reliability, rigidity, positioning accuracy and productivity and due to the lack of effective components for specialized PR. However, the basic trend worldwide is towards continuous growth in the use of PR for assembly. For example, the United States anticipated they will comprise 23 percent of the total by 1991, as against 3 percent in 1981, and Japan and the FRG anticipate figures of 22 and 21 percent by 1990, as against 19.1 and 5.2 percent in 1982. According to the FRG forecasts, 40 percent of all assembly jobs will have been robotized by 1990.

Increasing the effectiveness of PR use in assembly is achieved by using technological components of items being assembled, by standardizing and unitizing the items themselves, as well as both the components of those elements and the standard PR devices and subassemblies (drives, assembly and monitoring devices, grippers, instruction sets, micro-controllers, and so forth), by using standard assembly-process type-sizes, by using modular-design PR based on standard series of devices and subassemblies, by developing adaptive and specialized simple robots, by standardizing and unitizing peripheral process equipment which interacts with the robot, by ensuring it will mate with other process equipment, by increasing the functional potential of the grippers, assembly devices, tools and positioning and locating attachments, by simplifying PR components and their maintenance, by increasing the reliability of PR (mean time between failures of at least 5,000 hours), control computer operating life (to 20,000 hours or more) and linear link travel speed (up to 1.5-3 m/sec).

Analysis shows that the reasons for the lag in PR products mix and introduction into production to perform basic assembly operations in our country are poor reliability and operating life, significant dimensions and cost, less technological versatility and slower operation than foreign models, and the predominance of digital-control PR.

The creation of assembly PR with adaptive control and artificial intelligence, of robots possessing broad opportunities for adaptation to specific production conditions, is an important trend in the development of robotics abroad. It is assumed that Hitachi enterprises will soon be using such PR to perform 60 percent of all assembly. This will permit a 70-percent reduction in the number of assembly workers.

Unitization of the component elements of assembly PR and the development of unitized flexible modules for their mechanical parts, control devices and program support will permit the assembly of PR from series-produced, unitized flexible modules, the creation of highly efficient layouts for resolving specific technological tasks, and the optimum distribution of functions among the PR and the basic assembly equipment. The use of modular-design PR therefore significantly reduces

the time and expenses of modernizing assembly production and of developing and introducing new PR models, as well as reducing expenditures on their introduction and exploitation and simplifying maintenance.

It is generally appropriate to use rigidly programmable specialized PR for assembling simple items and microprocessor- and minicomputer-controlled adaptive PR for assembling complex items. It is therefore necessary to create a scientifically substantiated type-size range and to develop unitized flexible PR module designs (mechanical portion, control devices and program support) which can be used to arrange specialized and adaptive PR for a variety of target purposes in order to extensively robotize basic and auxiliary assembly operations.

The highest level of machine-building efficiency can be achieved by using complex enterprise FMS (KGPSP), which represent integrated, readjustable production systems on an enterprise-wide scale with an automated control system (ASUP). The latter ensures rapid reorganization of production technology when manufacturing an entire products mix consisting of various type-sizes throughout the production cycle: from receipt of order to production to delivery of the product to the customer.

KGPSP unifies all specialized enterprise production FMS: casting, forge-press, welding, machining, assembly and others.

The assembly-production FMS includes: an automated assembly production control system ASUSP (an ASUP subsystem) which ensures rapid reorganization of the assembly technology for the entire mix of products being produced by the enterprise, an assembly production data base, automated assembly item scientific research and design systems, automated technological preparation of production systems, and also a flexible enterprise assembly production technological complex. The latter unites all the flexible assembly technological complexes (GTKS) permitting the assembly of items throughout the technological cycle. The operation of all the GTKS is synchronized by a system controlling the entire work volume (including by computer).

The GTKS is an autonomously functioning group of readjustable, programmable process equipment which unifies automated systems for feeding and removing the items being assembled, replacing fixtures, monitoring and diagnostics. The system controlling the entire work volume being done at the complex includes computers.

The flexible technological cell capable of functioning autonomously is a structural element of the GTKS. It is a readjustable, programmable assembly device (ChPU machine tool, programmable chuck, PR, and so on) equipped with automated devices for loading and removing items being assembled, replacing fixtures, monitoring and diagnostics. The automated system for controlling the operation of all the devices comprising the cell includes minicomputers.

The cell transport systems can be unified by creating line, sector and shop GTKS. If the use of PR is anticipated, those complexes are considered to be robotized.

The cell elements are flexible functional devices for collecting and loading the items to be assembled, replacing tools, monitoring, and so forth, which devices consist of flexible modules ensuring the performance of an elementary action (such as straight-line travel, turning, gripping, and so forth). The system controlling their operation includes microcomputers and microprocessors.

Consequently, the assembly-production FMS is built as a hierarchy of various production units. At the lowest level, the flexible modules of the cells are combined into flexible functional devices, which are in turn combined into low-level flexible technological assembly complexes (lines). The latter are combined into sector GTKS, those into shop GTKS and, finally, those into the enterprise GTKS.

One task in increasing the effectiveness of assembly-production FMS is the creation of modular unitized standard readjustable basic and auxiliary equipment and all its elements: programmable assembly devices, loading, transport and monitoring devices, hoppers, positioners, locating and positioning attachments, control devices, algorithmic and program support. In other words, it is necessary to unitize and typize all elements comprising the enterprise assembly-production FMS.

In order to do this, one needs to develop the scientific principles of modular assembly FMS construction for machine building, as well as the type-size range and design of unitized modules and their standard configurations with consideration of technological compatibility in the various branches of industry. The leading branch technological planning organizations of all the machine-building branches, the Academy institutes and the VUZ's must participate in this work.

The centralized production of standard unitized modules should be set up at enterprises specially designated for those purposes.

Thus, increasing the effectiveness of assembly production is possible only by implementing a comprehensive, long range program. Such a program must be developed quickly. In this regard, it is necessary to change the practice of resolving partial, disconnected tasks and the practice of selectively mechanizing and automating assembly work. Rejection of the bureaucratic approach and unifying the efforts of scattered existing scientific and planning organizations will help create advanced assembly technology and devices based on unified scientific and methods principles.

The coordination and exchange of experience in the sphere of assembly work should be ensured and we should quickly change over to system-oriented, automated design and development of progressive standard technology and means of mechanizing and automating assembly for extensive application in the various branches of industry. We also need to centralize the manufacture of modern means of technological equipping of assembly production and to significantly increase production capacities for releasing assembly devices.

Moreover, it has become necessary to shape a center which would link together science, engineering, and production. This might be a scientific-production association comprised of a scientific-research technological and planning institute for the comprehensive mechanization and automation of assembly and a plant to manufacture and test prototype and series-produced standard assembly equipment. As a sort of accumulator of everything valuable that is available to modern science, engineering and leading experience, such an association could coordinate all work by the scientific, technological and planning organizations, plants and VUZ's in the field of the technology, mechanization and automation of assembly work. It must shape and implement a unified technical policy, work out scientific-technical and production solutions, and set up the release of prototypes of effective assembly mechanization and automation devices. In this regard, it is important that the organizations and enterprises developing the assembly technology and devices be subordinated to that particular association for assembly process mechanization and automation issues.

The creation of such a center would permit accelerating the concentration and specialization of assembly production, labor consolidation and the introduction of scientific achievements. It would become possible to work out the general, fundamental, bedrock problems of assembly production: progressive new technological processes, the methods, ways and means of assembly, scientifically substantiated principles of aggretizing and modularizing assembly equipment and also FMS assembly; optimal type-sizes and components of standard and typical flexible assembly-equipment process modules and highly effective specialized and adaptive assembly PR; computer-assisted SAPR for items being assembled, assembly technology, equipment and fixtures; normative-technical documentation on working out components of items being assembled and their elements for technological effectiveness for performing automated assembly.

In order to create a high scientific-technical level of assembly production in machine building, it is necessary to expand the training of highly skilled specialists in the field of assembly-process technology and automation (it is appropriate to institute the new specialty of assembly technology and automation in the higher and secondary technical academic institutions);

develop new methods of modelling and optimizing assembly processes, as well as SAPR for items being assembled and their elements, assembly technology, basic and auxiliary assembly equipment;

highly productive new technological assembly processes, methods, and methods;

a unified system of metrological support for assembly technological processes based on world metrological and measuring-equipment achievements;

methods of substantiating the principles of mechanization, automation, and robotization, as well as assembly-process working conditions calculations.

The scientific principles of a modular assembly FMS structure, of readjustable and programmable assembly equipment, standard arrangements, type-sizes and components of unitized modules with consideration of the technological compatibility in various branches of industry and ensuring high flexibility of assembly production; organizing the centralized production of the entire products mix of such modules with consideration of the requirements of machine-building enterprises;

assembly PR components with high technical characteristics, type-sizes, and modular components of specialized and adaptive assembly PR, as well as unitized and flexible modules of their mechanical portion, control devices and program support; organize the specialized production of flexible modules of these robots with consideration of the requirements of machine-building enterprises;

highly effective components of turning-assembly tools; organize their centralized production in an amount sufficient to the products mix and of high quality;

mechanization and automation device type-sizes and components for auxiliary, transport, warehousing and freight-handling in assembly production; organize their centralized production;

new methods and forms of organizing assembly processes for various production facilities with consideration of psychophysiological factors.

Increasing the effectiveness of assembly production in machine building, which has large potential reserves, will permit accelerating scientific-technical progress in industry, obtaining a significant economic impact and freeing labor resources.

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Facilities to House Automated Equipment Not up to Snuff

18610073 Moscow STROITELNAYA GAZETA in Russian 15 Dec 87 p 1

[Article by V. Azarenko under the rubric: "Priorities of the 5-year Plan Period: Machine Building Plat Construction Sites:" "Robots Also Need Heat"]

[Text] On 3 Mar 87, STROITELNAYA GAZETA [SG] published the article "Obligations to Flax Growers." The article discussed the protracted construction of the Bezhetsk agricultural machinery plant. The reaction to the criticism was immediate. In the responses received by the editing board, managers of the USSR Minselkhozmash [Ministry of agricultural machine building], Bezhetskselmash [Bezhetsk agricultural machinery] plant, and Giprokombaynprom [State institute for designing combine industry plants], tried to conceal the actual situation at the startup plant in order to protect the departmental colors. On 16 Jun 87 this newspaper in the article "They Were Fast to Respond" reported this attempt.

After the repeated report in SG, the editing board was informed that the criticism is recognized to be correct and the facts reported in the article were confirmed. Supposedly, concrete measures to accelerate the construction of the mechanical assembly shop are taken, and it is decided to expedite the delivery schedule of the most modern robotic equipment. SG was informed that the number of laborers is increased, and weekly scheduling meetings with participation of representatives of the CPSU Bezhetsk gorkom and Kalinin obkom are organized.

It seemed that the criticism was effective and the matter could be closed. However, the editing board decided to follow up the subject, and after 6 months decided to check one more time on the situation at the Bezhetskselmash.

Today, it seems, nothing reminds us that quite recently it was a construction site. The premises of the mechanical assembly shop No. 2 are clean. Workers are installing the first machine tools. The builders worked well at the construction of the administrative and service building. Outside walls of the building are painted, all interior works are completed, and the heating system is in operation. Workers lay out the last meters of linoleum.

In general, all things were showing that the situation at the plant became normal. The plan of construction and assembly works was realized at 102 percent. The first shipment of robotic machine tools arrived in the shop.

However, it looked so only at first glance.

The manager of the shop No.2 A. Korolev annoyedly said: "The builders fulfilled the plan indeed, but we do not know how to put the shop in service. Outside the weather is cold - 20 degrees C, but the shop heating unit has not been assembled yet, and we are short of electric cables for the delivered equipment. One month ago we received a transformer, but could not bring it into the plant. Now it is clear that we will not be able to start it before the year ends. And this transformer is the main culprit: a machine tool without power supply is only a chunk of metal."

This opinion is shared by the director of Glavuborochmash [Main department of harvesting machines building] at the USSR Minselkhozmash, V. Markov:

"Only a month ago the contractor and the client were determined to put the mechanical assembly shop No. 2 into operation. In order to achieve it, the general construction works were accelerated, utilities were brought in, installation of the ABK [ABK. Not identified further] was completed, and equipment deliveries were accelerated. However, all these efforts were in vain: the robotic lines can work only at a constant temperature, but nobody knows whether it will be in the shop until the year ends, There is one more problem. Plant management still has not decided what to do about the thermal insulation of the building walls: to install double-pane windows, or not.

Indeed, in spite of the fact that the situation at the construction site has improved, it still remains an alarming one. Neither the client, nor the contractor know how and where to build waste water lines; when the power supply lines to the mechanical assembly shop equipment will be ready; and how long it will take to fix gaps in the building roof.

I asked the deputy director of the Bezhetskselmash, Z. Kitayeva about all these problems.

Zoya Nikolayevna briefly answered: "It is all the fault of the builders. Address your questions to them." Then she added: "We will correct the deficiencies and will start the shop before the year ends."

Mildly speaking, this statement causes doubts: it is so similar to the daring assurances given to us by the former plant director. One should realize that only 2 weeks are left before the year ends.

13355

Use of Personal Computers To Carry Out Functional Cost Analysis of Production Output

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[Article by B.I. Maydanchik, doctor of economic sciences, and S.V. Shaldenkov, engineer]

[Text] The process of functional cost analysis is characterized by the multiple repetition of the operations of obtaining information, processing it, making sense of it, and making decisions, with a significant portion of these operations not being subject to strict formalization. It is for this reason that developments of programs intended for operation in an interactive mode are most promising. These programs make it possible to transfer to computers the very labor-intensive operations of retrieving information and converting it to the necessary research working group [IRG] in the form of any online computations, multicriterial evaluation, and selection of versions that are necessary.

The interactive operating mode assumes the creation of specified organizational conditions under which an IRG can sytematically conduct its meetings by making direct use of computers. Such conditions are, however, difficult to create in large computer centers. It is possible to have worksite equipment intended for use in conducting meetings of IRG and a video display terminal connected with an enterprise's computer center; however, the variation of creating an automated IRG workstation based on a personal computer must be considered less successful. In this case a link is established with an enterprise's existing automated management system [ASU] or automated design system [SAPR] to reference these systems' data bases or to use system programs intended to compute the components of designs and production processes, specific economic effectiveness, etc. In addition, the workstation should include its own automated data base. This data base should contain information about products' specifications; their technical documentation; information about analogues; functional, structural, and cost models of objects that have been analyzed previously; and lists of standard formulations of the functions that are characteristic of the products output by the specified enterprise.

Relational data bases are the most convenient to use when conducting a functional cost analysis because they present information in the form of two-dimensional tables—the most accessible method for users working with data bases. It affords the necessary flexibility, which is expressed in the online receipt of diverse information in necessary form as well as a relative simplicity of adding new data. A relational data base makes it possible to reconstruct data without changing applications programs, which is especially important for the development of a system when the sphere in which functional cost analysis is used is expanded. For these purposes, the applications programs developed for different analysis procedures should be more universal, and their structure should be minimally dependent on the specific type of object being analyzed. The ideal version is to create universal programs whose objective orientation may be specified by the makeup of the source data that are input into them.

We will examine the possible principles of designing programs to select an object to be analyzed in the preliminary stage of functional cost analysis. Such a selection may be based on the results of an expert evaluation that assumes the input of source data in an interactive mode with the subsequent calculation and printout of the information needed to make a final decision. When this is done, it is necessary to make certain that it is possible for the experts to formulate a set of evaluation criteria in a discussion process and that it is also possible to make full or partial use of a set of criteria that have been formulated previously and are now contained in a data base. In the case where a newly formulated set of criteria is used, the relative priorities of all criteria are calculated according to a formula where P_i is the relative priority of the i-th criterion, K_{ij} is the evaluation of the i-th criterion by the j-th expert in an arbitrary value system, n is the number of criteria in the formulated complex, and m is the number of experts.

In the case where only a portion of the criteria set contained in the data base is used, the priorities of these criteria relative to the set are known. For a complex that is being formulated, the recalculation of the relative priorities is done according to a formula where P_i is the relative priority of the i-th criterion in the set being formulated, P'_i is the relative priority of the i-th criterion in the source set, and n is the number of criteria selected from the source set and included in the set being formulated.

In this case the criteria in the set being formulated may be selected in an interactive mode by showing experts the entire set of criteria contained in the automated data

base [ADB], after which the experts decide whether each of these criteria is suitable for use in evaluating the specific set of potential objects to be analyzed.

After the criteria set has been formulated, the experts complete their evaluations and calculate the relative priorities of the objects with respect to each of these criteria. This calculation is done according to a formula where r_{ijk} is the relative priority of the k-th version with respect to the i-th criterion based on the evaluations of the j-th expert; K_{ijk} is the evaluation of the i-th criterion by the j-th expert of the k-th version of the object in a random value system, and l is the number of versions of the analysis of the object that are being considered.

If, in accordance with the criteria set, objects may be characterized by parameters whose values are known and contained in a data base, the relative priorities for cases where it is desirable to select objects with maximal values of the parameter R may be computed according to a formula where r_{ik} is the relative priority of the k-th version of the object according to the i-th criterion and R_{ik} is the value of the parameter characterizing the k-th version of the object according to the i-th criterion.

If it is preferable that an object with a maximal value of the parameter R be selected, a formula is used.

Then, if the relative priorities of the objects are found in accordance with formula (1), their combined priorities may be computed according to another formula.

If the objects' final priorities are found in accordance with formula (2) or formula (3), their combined priorities may be determined.

The results of the computation may be output to a display screen or printer. The version characterized by the maximal-value combined priority is selected as the object of the analysis.

We will examine programs for formulating structural models and printing out block diagrams as an example of automation in the information stage of functional cost analysis. When there is an automated data base present, the model may be constructed by selecting and processing information contained in the automated data base. It is also possible to input necessary data in an interactive mode, in which case the design documentation may serve as the user's information source. First of all, the model provides general information about the object being analyzed (its name, sketch number, quantity measurement units, quantity indicator). Then, in response to program requests, it provides information about the object's components at the top structural level. Represented in the form of a block diagram, the model acquires a form analogous to that presented in Figure 1. After the input of data pertaining to the top-level components has been completed, the user is asked whether any further breakdown of each component into its component parts is feasible. In the event of a positive response, data pertaining to the lower-level components is requested. The block diagram acquires the form presented in Figure 2. The number of levels in a model can reach several tens; however, for each specific case the degree of decomposition of an object is determined with an allowance for its complexity and the goals of the operation being conducted. The diagram is printed out onto individual sheets that will be joined later. Thus, in Figure 2 component no. 6 "Flange" is automatically transferred to the next page.

Figure 1 shows audio system 464326.001S6, quantity—1 unit, component no. 1, subordination no. 1; chassis 469532.001S6, quantity—1 unit, component no. 2, subordination no. 1; cover 469545.001S6, quantity—1 unit, component no. 3, subordination no. 1; switch 642285 469545.001S6, quantity—1 unit, component no. 4, subordination no. 1; packaging 305835.001S6, quantity—1 unit, component no. 5, subordination no. 1; Flange 301511.001S6, quantity—1 unit, component no. 6, subordination no. 1.

Figure 2 shows audio system 464326.001S6, quantity—1 unit, component no. 1, subordination no. 1; chassis 469532.001S6, quantity—1 unit, component no. 2, subordination no. 1; cover 469545.001S6, quantity—1 unit, component no. 3, subordination no. 1; switch 642285 469545.001S6, quantity—1 unit, component no. 4, subordination no. 1; packaging 305835.001S6, quantity—1 unit, component no. 5, subordination no. 1; cover 301174.001S6, quantity—1 unit, component no. 7, subordination no. 3; base 301314.002S6, quantity—1 unit, component no. 8, subordination no. 3; panel 686461.001S6, quantity—1 unit, component no. 9, subordination no. 4; clamp 745485.001S6, quantity—1 unit, component no. 10, subordination no. 4; box 321335.001S6, quantity—1 unit, component no. 11, subordination no. 5; gasket 754152.005, quantity—1 unit, component no. 12, subordination no. 5.

It is advisable that it be possible to reference the automated data base during the process of the interactive formulation of the model, which will make it possible for the user to obtain online information about the manner in which components having the same name have been implemented in different objects. In the case of the interactive formulation of a model, it is also necessary that all newly obtained information be transferred to the data base.

The formulated, tested, and corrected block diagram is the input information for the subsequent procedures of the analysis. Thus, it can serve as the basis for formulating a structural cost model, in which case the component sketch numbers contained in the model can play the role of keys when queries to the automated data base are formulated. It should also be possible to formulate a structural cost model in an interactive mode, in which case it is also advisable to allow the possibility of referencing the automated data base, which will make it possible for the user to obtain online information about

whether the data base contains cost information on components having the same names as those contained in the model. When necessary, this information may be output to a display screen or alphanumeric printer for further use in comparisons during the analytical stage.

It is possible to transfer all newly obtained information to the data base after the interactive formulation of a structural cost model has been completed.

Programs for formulating models and printing out functional diagrams and analytical charts on each of an object's components may be examined as an example of automation in the analytical stage of functional cost analysis (Figrue 3). Figure 3 shows how to reproduce a disk recording with audio system 464326.001S6, main function no. 1, subordination no. $1/E_+$; convert electrical oscillations into sound with cover 469545.001S6, basic function no. 2, subordination no. $1/E_+$; radiate acoustic waves with the dynamic loudspeaker, main function no. 5, subordination no. $2/E_-$; and protect the dynamic loudspeaker against damage with the frame, optional function no. 6, subordination no. $2/E_+$.

A modified FAST method using nine questions to activate the formulation of functions has been adopted as the basis of the algorithm for formulating the functional models. The program is intended to operate in an interactive mode and contains seven groups of questions, with four groups being cyclically repeated in relation to all of the functions being formulated as each of the model's levels is constructed.

The **first group** of questions is geared toward formulating the maximum number of versions of the main function of the object being analyzed [GF]. In response to the program's requests, the user inputs the object's name, sketch number, and up to 10 versions of formulations of the main function. Next, the function of the subsystem [FN], which is determined by the existence of the specified version of the main function, is formulated relative to each of the input versions with the help of the **second group** of questions. The set of formulated supersystem functions is presented to the user so that he or she can evaluate them and select a single version relative to which the correctness of all versions of the main function will be tested. The test is reduced to a determination of the presence of a cause-and-effect relationship between the supersystem function and each of the versions of the main function. When there is no such connection, the formulation is excluded from any further examination. It is assumed that from the last analysis of the versions the user will select the most general version, i.e., the one that includes as many of the other versions as possible. This version will be viewed as the final formulation of the main function. If no version passes the test, the previously described steps of the program are repeated. The set of procedures described is intended to increase the reliability of the formulation of the main function, which makes the further formulation of intraobject functions much easier. The probability of logical errors when a model is constructed is also reduced because the intraobject functions of each of the levels are formulated by the decomposition of the higher-level functions.

The model may also include functions whose execution is not conditioned by the main function. The existence of these functions is, as a rule, specified by an object's operating conditions or by a different sort of additional requirements imposed on it. Such functions as aesthetics, reliability, resistance to the environment, compactness, etc., may play this type of role. In response to the **third group** of questions the user inputs the formulation of such a function and its designation, which consists of letters. This designation is automatically included in the printout functional diagram with a plus (+) or minus (-) sign, depending on whether or not the material carrier performs such a function. Thus Figure 3 is a fragment of the functional diagram in which all the material carriers of functions except the component "Dynamic loudspeaker" have aesthetic functions (which is designated by the symbol E_+).

The **fourth group** of questions is intended for use in formulating the intraobject functions that permit the implementation of the main function, with the user being able to include the names and numbers of sketches realizing the functions' material carriers in addition to the formulation of the functions themselves.

The **fifth group** of questions is geared toward discovering erroneously input functions. This is done by determining the presence of cause-and-effect relationships between one level of functions derived during the decomposition of some higher-level functions. The discovery of such a connection means that one of the functions being compared has conditioned the existence of the other. In this case, the conditioned function is removed from the model and a message recommending that the input of the formulation of this function be repeated in a lower-level model is sent to the user.

The **sixth group** of questions is directed toward specifying the rank of the formulated functions. This is done by suggesting that the user respond as to whether it will still be possible to implement the main function and intraobject functions if the function under examination is removed from the model. Based on the user's answers to this group of questions, the program is capable of subdividing the intraobject functions that have been formulated into basic, auxiliary, and optional functions.

The **seventh group** of questions is geared toward discovering which of the material carriers that have been included in the model perform the functions that the user has formulated as answers to the third group of questions asked of him.

The questions in groups 4 through 7 are cyclically repeated, with the previously input formulations as well as the names and numbers of the sketches of their material carriers being used when their texts are formulated.

The functional diagrams are printed out on separate, sequentially connected sheets analogously to the block diagrams. Analytical charts are printed out by selecting information on each material carrier from the files of the formulated functional model. A chart contains the formulations of all the functions implemented by a specified material carrier as well as the ranks of these functions. A set of such charts is used by the research working group when determining the resource of the functions and selecting the areas of an object to be changed. The analytical charts may be output to an alphanumeric printer or to a video terminal screen.

The prospects for the development of a program to formulate functional models lies in making it possible for such a program to interact with an automated data base. Such interaction should make it possible for the user to obtain information about the manner in which certain functions or others are implemented in different products while he is in the process of interactively formulating a model. The online receipt of such data will make it possible to accelerate the formulation of a model and will reduce the probability of constructing it erroneously.

Just as during the formulation of structural and structural cost models, so too is it necessary to transfer all newly obtained information to a data base when a functional model is formulated. Such an approach to filling an automate data base will lead to the accumulation in each enterprise of information about the objects that are most characteristic of that particular enterprise. Taken together, similar information from a group of enterprises can serve to develop subsectorial and sectorial classification systems and function lists. The direct exchange of this type of information between different enterprises to fill a data base is also possible.

The structural, structural cost, and functional models formulated may be subject to a different type of joint research intended to formulate specific tasks for examination in the creative stage of functional cost analysis. Besides task formulations, the task file that is the input information for the creative stage should also contain cost information suitable for preliminary calculation of decisions' economic effectiveness.

Of the number of methods used to find technical ideas and decisions, the one most frequently used in the creative stage of functional cost analysis is morphological analysis. It is relatively easy to formalize.

The program for selecting versions from the formulated morphological box, which is intended for operation in an interactive model, makes it possible first of all to specify the criteria according to which it will be possible to evaluate the set of potential decisions being examined. The criteria selection process is analogous to that described for the procedure for determining the object to be analyzed. This is followed by an expert evaluation of the value of an object's features that have been made the basis the morphological box that has been constructed as well as by an expert evaluation of the alternative versions of implementing each feature. This evaluation is conducted relative to each of the criteria. After the evaluation, it is necessary to calculate the priorities of all of the versions contained in the morphological box. Each version is analyzed individually from the standpoint of each of the criteria.

The principle of preliminary constraints on the search field relative to all the criteria lies at the basis of the selection, with the versions satisfying all of the specified constraints being selected for final examination. In the case where none of the versions satisfy these constraints, the search field may be expanded.

Both explicit specification of the search fields in the form of ranges of the values of the priorities as well as their implicit specification in the expert evaluation stage should be permitted. In the latter case, besides the existing alternative versions of implementing each function, some conditional version (the X-version), which does not have a constructive embodiment but which nevertheless has all of the properties that would support the forecasting of an "average good solution," is evaluated. The priority of combining the X-versions is calculated with respect to each of the criteria, and the value obtained is taken as the center of the search area relative to the specific criterion.

A search based on such an algorithm may be conducted either to obtain a unique solution, the value of whose priorities is closest to the values of the priorities of the combination of the X-version relative to each of the criteria, or else to find some previously specified number of versions, which is done by gradually expanding the search field to all of the criteria.

The experience that has been accumulated thus far is currently being used as the basis for developing a standard functional cost analysis methodology that can be applied when personal computers are used in modernization efforts.

12794

Wise Automation Philosophy, Equipment Choices Urged

18610177 Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 16 Mar 88 p 2

[Article by Doctor of Technical Sciences Professor L. Volchkevich "FAP: Plans and Reality," under the "Acceleration Reserves: News" rubric]

[Text] It was just recently that a fancy word "FAP" [flexible automated production] was in all newspapers and magazines and on all TV screens, symbolizing

paramount S&T progress. But today we have entered the time of bashful omission. At best, FAPs will be mentioned after a comma in a list of future accomplishments. But often one can also hear that the idea of FAPs and flexible manufacturing systems (FMS) has not justified the hopes.

Unfortunately, there **are** grounds for doubt: our practice of developing and operating FMS gives plenty. The system at the Vilnius Machine Tool Building Plant "Zhalgiris," which was many times described in SOTSIALISTICHESKAYA INDUSTRIYA, is far from being the worst one. In some FMS, the time is as high as 33%, and machining accuracy is such that it precludes the possibility to manufacture finished parts: one has to finish them using... universal machine tools.

But nowadays enterprise personnel are more concerned with FMS economics. If, for instance, one compares a system for machining base members with a bay of universal machine tools that have the same capacity, it will turn out that the FMS is 20 to 30 times more expensive! Granted, daily FMS output is 2-2.2 times higher, and it is manned by 2-2.5 times fewer workers. But this does not save the situation: usually, product cost at FMS is 3 to 4 times higher, and capital productivity is 12 to 15 times lower.

These indices, multiplied by the large-scale program of FMS implementation, are fraught with losses in the billions of rubles. Does this mean, though, that the very idea of flexible automation is wasteful and bankrupting? Or are we discrediting it with our insatiable passion for campaigning? And with our unwillingness to draw lessons from our earlier mistakes?

Let us recall the recent robotization campaign. Influenced by foreign companies' commercials, some of our professionals saw in robots a panacea that could transform any type of production. Due to their efforts, robot implementation plans that were lacking both technical and economic feasibility were imposed on a large number of enterprises. And scientific strategy was replaced with the formula: "No matter where, no matter what kind: the important thing is to have as many robots as possible!"

The results are known all too well. When, for instance, the USSR Committee of People's Control conducted three years ago a random check of robotization efficiency, the picture that had been revealed staggered even the inspectors who had seen a thing or two before. The economic efficiency of implementation of 600 robots that cost over R10 million was equal to... R18,000 a year. And the chance to free up one worker was paid for by... 14 robots on average!

Specialists at the USSR Gosplan, GKNT [USSR State Committee for Science and Technology] and leading Ministries were aware of the situation. But when the time came to make decisions on flexible automation, the history repeated itself. Almost literally. Once again, an FMS is elevated to the rank of panacea, once again technical and economic justification is ignored, again the significant "abroad..." is played.

When we see a circus magician swallowing swords, we are not rushing to repeat the trick. We know: one needs practice, training and equipment. But in the FMS case common sense itself was buried to oblivion. When plans were compiled, we had neither experience nor personnel nor any stock of scientific research on hand. Just a few flexible lines were in operation in the country, and those were far from perfection. But such "minor things" did not bother panacea fans. The plan was made to implement almost 2,000 FMS during the current Five-Year Plan. Each FMS is a very complex set of CNC machine tools and robots, automated warehouses and toolchangers, electronic control systems and sensitive transducers. Two thousand such sets would be a giant leap even for the most developed countries. In order to make it easier, one should at least have created a scientific center on flexible automation capable to give clear recommendations to production workers.

Instead, enterprises virtually had been given complete control over FMS development and implementation. In order to meet targets, a lot of enterprises literally had to start from scratch, rediscovering "Americas" and reinventing the wheel. Although Ministries understood the fallacious character of this practice, they were not sparing money for "FAP-ization". And they were eagerly accepting reports on FMS implementation and "savings that had been realized". And Minstankoprom [USSR Ministry of Machine Tool and Tool Building Industry] has even given bonuses to the authors of such report from the Kirovakan Precision Machine Tool Plant, although at the moment the FMS developed by the plant had not produced a single part.

When economic irresponsibility is amplified by personal impunity, one can anticipate failures of any kind. For instance, in 1986 ENIIMS [Experimental Scientific Research Institute of Metal Cutting Machine Tools], the Minstankoprom head institute, inspected about 300 enterprise applications for FMS development. Professionals decided that only 36 applications were justified and technically competent. But in spite of this, all FMS were included into the Gosplan "Title List" - for the same sake of reporting.

At present, the flexible automation problem is sort of in the limbo. It is understandable: those who were whipping up the "FAP-ization" campaign don't even want to hear about it. But the situation cannot last forever. The mechanism has been triggered and keeps rotating by inertia, multiplying miscalculations and losses. So far, only the public has been trying to stop it. Our Committee on Automation and Mechanization of Production Processes, Union of Scientific and Engineering Societies

(SNIO), is part of the public. But specialists at the majority of Ministries and agencies keep their Olympic composure, assuming that the problem will soon die by itself.

These hopes are not completely groundless. After converting to self-accounting [khozraschet] and self-financing, enterprises will hardly have a desire to bother with unprofitable FMS. They will dismantle them at their earliest opportunity, setting up machine tools for independent operation. There wil be no need anymore for conducting research, developing improved systems and devices and training skilled personnel. And several years later we will again start... making up, catching up and passing ahead...

This must not be allowed to happen! Flexible automation is the future of production in various industries. There is a certain regularity in the fact that the first generation FMS had not produced the dividends they were expected to: huge breakthroughs must be carefully prepared. For instance, we spend millions of rubles for exploration drilling before mastering a large deposit. The flexible automation problem alsorequires deep exploration. It is first of all necessary in order to develop a strategy.

Production automation experience demonstrates that efficiency of automation depends not only on hardware perfection. Great role is also played by accurate selection of the field where automation is being implemented. The majority of FMS developed in our country work in machine shops at enterprises with series and small-series production. It is these very enterprises that are covered in a new concept developed by specialists at GKNT SSSR. But can one be sure that this choice is faultless?

One of arguments for it is that only due to FMS one has for the first time the possibility of integrated automation thereof. And 70 to 75 percent of products of the machine building industry are made by these enterprises.

This is all true. But let us use a simple analogy. In our country, 20 to 25 percent of coal deposits are close to the surface, whereas the rest are very deep, where one cannot successfully mine them. Apparently, even a layman will tell you that at the beginning one should conduct strip mining, wherein high-efficiency equipment can be used, and at the same time work out a technology for economically efficient mastering of deep strata. A question comes up: why in the case of FMS are we trying to go deep from the very beginning?

Maybe, this is because in mass production everything that could have been automated has been? No. For instance, in our automotive industry only 10 percent of equipment is used in automated lines, vs. 35 percent in the USA. The share of universal machine tools in the industry is approximately 25 percent here vs. 12 percent in the USA. One can see that automation enthusiasts have room for expansion.

Practice of recent years has made it possible to define clear criteria, and most of them are in favor of automating mass production. Trends that have formed abroad are another testimony to this fact. Particularly, according to VNIITEMR [not further identified], theMinstankoprom head information institute, around 60 percent of FMS recently created in industrially developed countries are designed for flexible large-series and mass produciton.

True, in order to realize maximum possible returns, it will be necessary to make certain structural changes. But they have long ago become imminent in our industry. Particularly, we are talking of such cost-cutting tool as production specialization. Unfortunately, in our country only about 3 percent of parts for general use in the machine building industry are manufactured at specialized enterprises, vs. 50 to 60 percent in capitalistic countries. Two-thirds of our plants and associations manufacture fasteners for their in-house use. 2,000 enterprises make gears, as in natural economy, whereas, similarly to bearings, gear manufacturing can be concentrated at a couple dozen of specialized production facilities. It is in such facilities that FMS would operate, so to speak, in their natural environment.

Foreign professionals also correct their programs. Just not long ago they were forecasting that, for instance, by 1985 Japan would manufacture up to 20 percent of industrial products using FMS. And that in 1990 tens of thousands of flexible systems would be in operation in the world. Alas, these forecasts will not materialize. According to calculations made by professionals of the KAMAU company (Italy), in 1990 only 230 FMS will be in operation in the entire Western Europe, including 70 in FRG [the Federal Republic of Germany] and 45 in France.

Qualitative changes are also on the agenda. FMS for such processes as PCB and microcircuit assembly, painting, welding, heat treatment and galvanic coating are being implemented in the world at a faster pace. In other words, flexible automation is invading those fields where, with relatively small expenditures, it facilitates productivity growth, improves product quality and eliminates the need for operators in zones with hazardous labor conditions.

This indicates that we are now at the turning point, when the problem of flexible automation strategy must be discussed broadly and with proper concern.

12770

Better Control Systems, More Metallurgy Automation Urged

18610181 Moscow STROITELNAYA GAZETA in Russian 9 Apr 88 p 2

[Article by Candidate of Technical Sciences D. Mukanov, Director of Special Design and Planning Bureau, NPO [scientific production association] "Chermetavtomatika" (Karaganda): "Computer for Dessert: Industrial Electronics in Cinderella Position"]

[Text] The Karaganda Metallurgical Combine did not fulfill the last year plan. Several reasons for this are given. One of them is underestimation of the role of

automation devices and electronics during construction and modernization of production departments and equipment.

These systems are installed according to cut-down schemes and are the last ones to be installed. Quite often they are installed only after a production department or equipment starts producing. Nowadays automation is treated as a dessert which beautifies the life but which one can live without in the beginning.

The combine tinplate department has been built recently, and it uses modern technology. Here, imperfections of the existing system of planning and organization of work at construction projects can be clearly seen. Countless designers and manufacturers were having their own ways, delivering automation equipment made to their own tastes and, of course, without testing for compatibility with main equipment. The customer, being under stress and nagged by persistent requirements to start making products that were needed "by yesterday", was forced to take whatever he was given.

And when the department finally started operation and the installation and testing of automation equipment begun, it was not easy at all to bring the equipment to working condition. Low quality added to design flaws. And on top of this, it turned out that characteristics of main and automation equipment did not quite match.

It has been less than three years since a six-stand roling mill in the tinplate department was commissioned, but the operating personnel is forced to modernize or even shut off certain control systems.

Nowadays one can only improve metal quality on the basis of broad automation and mechanization within the program of retooling production departments. Unfortunately, when undertaking construction and modernization of production departments, Minchermet SSSR [USSR Ministry of Ferrous Metallurgy] looks to Minpribor SSSR [USSR Ministry of Instrument Making, Automation Equipment and Control Systems] and Minelektrotekhporm SSSR [USSR Ministry of Electrical Equipment Industry], while automation professionals in our industry are reduced to the role of coordinators and inspectors. A good example is the activity of our OPKB [Special Design and Planning Bureau], Experimental Mechanical Plant and Startup and Setup Administration of the Moscow NPO "Chermetavtomatika". Their role in solving problems of automation of technological processes does not match their real capabilities.

We shall again use the tinplate department as an example. While professionals from the two Ministries were installing and mastering automation equipment in the department, the role of OPKB professionals was only reduced to organizational work. We were writing memos and participating in meetings. And even under those conditions we managed to implement at the combine a number of technical innovations.

Here is another example. Some time ago the OPKB had installed a set of automation systems at the "1700" hot-rolling mill. But when the modernization time came, this job was given to Minpribor SSSR. What for? The OPKB professionals could have done it. Reliability of the devices has been proven by many years of operation.

We think that for automation in production departments of metallurgical enterprises not to be in the Cinderella position, implementation of complex projects should be assigned to Minchermet SSSR scientific and design organizations, which if needed will invite help from other Ministries. The industry science will be able to manage all stages of the "Development - Manufacturing - Delivery" cycle and commission the ASU [automated control system]. It makes more sense to charge Minpribor and Minelektrotekhprom with the development of unique integrated multimachine ASU that are of intersectorial importance.

At the same time, it is about time to renounce the fallacious practice whereas by cutting expenses for automation imaginary savings are shown at the design stage. It is well known that in the USA metallurgy these expenses constitute 15 to 17 percent of the project cost, wheres here they are hardly 3 to 4 percent.

Economic efficiency of automation implementation is also reduced because the industry needs small quantities of various special instruments. Usually, Minchermet files a request for development thereof and sends it to Minpribor. Years are going by, but only few instruments are being born. And it cannot be otherwise, as nobody wants to bother with small lots.

There is only one solution to the situation: have Minpribor develop instruments for general industrial applications and let the industry professionals deal with special instruments.

The Karaganda Metallurgical Combine of today is kind of an electronics museum. Each of 50 NII [scientific research insitutes] delivers products that have their own elementary base. Next to state-of-the-art instruments and computers, one can also see in production departments instruments that use electronic tubes from the first postwar TV set KVN. Production of these latter and a lot of other instruments has been discontinued. It is not easy to service them. Even worse, this automation equipment is unreliable and does not make it possible to manufacture products of required quality.

In recent years, the OPKB has offered more instruments for the blast furnace process than all Minpribor organizations. Some of those instruments were tried out at the Kazakhstan Magnitka and are exported. But it is not only these results that are making metallurgists to turn about face to the industry science. The main role has been played by self-accounting [khozraschet] and conversion to self-financing. Customers began counting not

just the number of installed instruments but also their cost. Metallurgists are interested in series-produced instruments which are much less expensive.

Our OPKB too has converted to full self-accounting and self-financing. We have immediately reviewed product nomenclature and chosen new technical directions. We have switched from developing individual instruments to designing integrated ASU. We are developing an ASU for mixing and getting ready to develop an ASU for blast-furnace smelting.

Strenuous work is underway. The lack of computers is in the way of OPKB professionals. This is our heel of Ahilles. It is paradoxical, but we have fewer computers than our customers. We are renting computer time on the outside and looking forward to the time when we will be able to use our profits to buy computers. We only have one problem: will we be allowed to buy at least one modern computer with our own money? After all, the cobbler cannot be without shoes forever.

12770

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Rotary Conveyor, Automation's Role by Year 2000 Viewed

18610184 Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 1, Jan 88 pp 1-3

[Article by Deputy Director of Ukrniinti [Ukrainian Scientific Research Institute of Technical and Economic Information and Technical and Economic Studies], Candidate of Technical Sciences G.I. Kalitich and Engineer V.S. Strokan: "Important Direction of Acceleration of S&T Progress"]

[Text] "Main Directions of USSR Economic and Social Development in 1986-1990 and for the Period Up to the Year 2000" provide for solving problems of integrated automation of production that would result in asignificant increase in labor productivity and production output, improved product quality and lower cost.

The most efficient way to automate individual and small-series production is to use flexible production systems. For large-series and mass production of small-size products with simple geometric shape the most efficient way is to use automated rotary complexes based on automatic rotary and rotary-conveyor lines (ARL and ARCL).

In May of 1986, Politburo of the CPSU Central Committee reviewed problems related to accelerating ARL and ARCL implementation in the national economy. It was noted that to organize mass production of new generation equipment, particularly rotary lines that provide multiple increase in labor productivity and improved product quality is a goal of special importance. All leading machine building Ministries are involved in the development of the lines.

The idea of rotary lines was born in our country during the Great Patriotic war. Their implementation in the USSR national economy began in 1960's, when the goal was set to automate production as one of the main ways to accelerate S&T progress. At present, there are approximately 3,000 various ARL and ARCL in the country, each performing 2 to 12 different technological operations at a rate of 120-1,200 parts per minute.

In machine building, the following operations are performed at ARL and ARCL: cold and hot stamping; plastics processing; metal powder compaction; turning (making shaft-type parts); investment, die and permanent-mold casting; heat treatment (annealing, hardening, drying etc.); chemical treatment (etching, degreasing, phosphatizing etc.); coating (lacquering, painting, galvanic coating, stensiling etc.); and control of parts linear dimensions and shape.

Scientific research of respective directions in the theory of rotary-type technological equipment facilitate to a great extent the borad spreading of the lines. A large number of projects resulted in developing technical solutions at the invention level. The largest number of projects at the invention level have been developed at the KB [design bureau] of intersectorial S&T complex "Rotor", Tula Polytechnic Institute, Tula PKTI [Planning and Design Technological Institute] Proektin, Scientific Research and Experimental Institute of Automotive and Tractor Electrical Equipment and Automotive Devices, and at the former Zhdanov Branch of the Special Design and Planning Bureau of the Medical Industry.

Studies of experience in the design of machining ARL at organizations of Minstankoprom SSSR [USSR Ministry of Machine Tool and Tool Building Industry] and other Minsitries have demonstrated that rotary lines can be used either independently, for performing the entire machning cycle, or in integrated lines or in systems of automated lines that perform a certain set of operations.

Being an important component of means of production, rotary lines, besides radically changing labor content and methods, affect a respective level of production management. This proves K. Marx's idea that economic eras differ in how, using what means of labor things are manufactured, rather than in what kind of things are manufactured.

At present, projects of integrated automated production facilities equipped with computerized automated control systems are being developed. Only in the case of integrated production automation, wherein not only technological processes but also the majority of ancillary operations and production management are automated, technical capabilities and economic parameters of ARL

and ARCL can be realized to their fullest extent. Thus, development of integrated automated production facilities makes it possible to cut inter- and intrashop transport by a factor of 5 to 10, increase equipment productivity four-to sixfold, reduce product labor content by a factor of 3 to 4 and production area by a factor of 2.7 to 3, and reduce production cycle by a factor of 10 to 20.

Rigid kinematic connection of technological and transporting rotors in ARL and ARCL ensures continuity and uniformity in processing product flow and controllability of the technological process. This considerably simplifies production control and makes it possible to significantly reduce the number of ancillary production personnel and cut unproductive equipment downtime.

Team service that uses necessary means of office mechanization and on-line control is the most advanced form of organization of work in an intgegrated automated production based on ARL and ARCL. Thus, automated production and the most advanced form of organization of work, team work, combine into an integral whole.

High operating reliability of ARL and ARCL, ability to regulate them, continuity and controllability of the technological process and team forms of service provide a realistic possibility of manless operation of integrated automated production facilities.

Integrated automated production facilities based on multinomenclature ARL and ARCL can be incorporated into flexible production systems. In this case, one must make sure that a change from one part to the next takes place without stopping the line or with stopping it for the shortest possible time; one must also ensure that the equipment is highly failureproof and can self-recover automatically, without man's interference.

Intensification of work on production automation based on ARL and ARCL is the mainline direction in reducing expenses and improving product quality, which becomes especially important when enterprises are converting to full self-accounting [khozraschet] and self-financing. At the meeting at the CPSU Central Committee on November 14, 1986, where problems of introducing State acceptance at associations and enterprises of industrial Ministries were discussed, the importance of ARL and ARCL implementation for ensuring stable product quality was specifically stressed.

In order to implement ARL and ARCL in various sectors of the national economy, and first of all in the precise machine building, instrument making and food industries, as soon as possible, intersectorial S&T complex "Rotor" has been created. Head scientific research and design organizations have been designated; under the guidance of the leading KB [design bureau], they will develop automated lines for their respective industries and study demand therefor. The nomenclature of these lines has been assigned to various machine building Ministries. During the 12th Five-Year Plan it is planned to create 8,450 ARL and ARCL in the country.

Great attention is being paid to educating specialists in rotary-type machinery. Beginning in 1988, it is planned to graduate at least 200 engineers and technicians in the design and development of these lines, and at least 700 engineers and technicians in setup, service and repair thereof. Large-scale construction has been planned in order to provide training-methodological and scientific-experimental base.

In the Ukrainian SSR there are now about 400 ARL and ARCL in operation. Their share in the total amount of automated lines used in the Republic national economy is approximately 6%, and they are mainly used in machine building and metalworking.

Despite the fact that effectiveness of implementation of rotary complexes in large-series and mass production has been proved, not enough attention is being paid in the Republic to their development and implementation. Therefore, studying organizational, economic, social and technical problems related to broad implementation of ARL and ARCL at all stages of the S&T cycle (science - technology - production - operation) and issuing information versions of management decisions related to this problem, based on the development of thesis, analytical and synthetic models, is an important task of information services.

It seems feasible to build a special pavillion at the VDNKh USSR [UkSSR Exhibition of Achievements in National Economy] and organize advanced experience schools for all professionals in the rotary machine field.

The time is ripe for creating in the majority of the Republic technical VUZs Chairs similar to that at MVTU [Moscow Higher Technical School] imeni N.E. Bauman.

At present, one of urgent problems professionals in various fields are working on is the optimum selection of objects for integrated automation using ARL and ACRL, in order to ensure high efficiency of utilization thereof. Soundness and optimality of decisions made in the process are of principal importance, because they will form the foundation for long-term integrated programs and Five-Year Plans of enterprises modernization and retooling.

Development and wide implementation of rotary complexes facilitate successful accomplishment of radical restructuring of the country's production potential.

12770

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Design Automation of Drawing Dies of Multiposition Presses

18610188 Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 2, Feb 88 pp 22-23

[Article by Yu.V. Skachko, L.S. Shabeka and A.A. Darymov under rubric "Technology of Sheet Presswork"]

[Text] High productivity of sheet presswork, as a rule, is achieved either by the intensification of operation and concentration of the manufacturing steps in one die, or by transferring parts to multipositional automatic presses. In such a stamping line there are usually located four to eight dies, for which the parameters of the press, the space under the dies, the attachment of the upper plate etc. are identical. The number of types of multipositional automatic presses at enterprises is usually insignificant, and this creates good premises for the creation of SAPR [Automatic Design System] dies for multipositional presses.

Design typicalization is the foremost premise for the creation of SAPR. The design of the die, developed by the authors (Fig.), is the basis for drawing dies of multipositional presses which implement the drawing of cylindrical and rectangular parts with or without a flange on the first pass. The dimensions of the parts of this design are calculated on a computer because, for each part, algorithms have been developed which simulate its design. The description (coding) of the drawings of the basic parts of the die are written in geometric GIMAP (1) simulation language in which the spatial image of the part is formed by the assumption of the "rotation group" type or "translation group" and their combinations. The translator in this language makes it possible to change the description of the part to FORTRAN-IV.

The drawing die makes it possible to draw parts from intermediate products made in the blanking die of the multipositional press. Since the intermediate products are fed by automatic clamp hooks, an algorithm was developed to calculate the required distances between the die columns to create free movement of the clamps in the zone of the columns.

The drawing die along with other dies in this line are installed on common plate 2 which, in its turn, is attached to the plate of the press. In the process of operation, the intermediate product is fed by the clamp hooks along the surface of the die to the deformation zone. When the upper half of the die moves down, the intermediate product is centered with respect to plunger 3 by catchers (not shown in the Figure). During the working stroke, clamp 4 moves along the guide plank-.The force on the clamp which prevents the formation of folds is transmitted by stud buffers 1. In the reverse stroke, the obtained part is removed from the plunger by the clamp and remains pressed down to the surface of the die without displacement to the side due to the clamp provided in the upper part of the die (parts 5, 6, 7), which operates before the start of the movement of the hook clamps.

Algorithms for calculating the plunger and the female die which simulate their design process, although developed for s specific typical design, are universal to a certain extent. They are applicable in calculating the parts of the plunger and female die for round parts with or without a flange and do not depend on the type of presses and design of the die. Algorithms simulating the design of the remaining parts, are applicable only to a given type of design.

The following is used as initial data in the automatic design of the die:

diameter of the intermediate product;

geometrical shape required after the given manufacturing step on the part described in the GIMAP language;

dimensions of this geometrical shape with identifiers assigned to it;

brand of material;

drawing manufacturing step according to the code.

At the output of the system, there are produced drawings of the die parts with specific dimensions, their tolerances and other parameters required for the manufacture of these parts.

Figure 2 shows a typical design of a die for the second and following manufacturing steps of a multipositional press mounted on the same installation plate as the die of the first manufacturing step. When the upper half of the die moves down, fingers 5 touch plate 4 which is flush-mounted with plate 6 and sinks it in the the lower plate of the die. At the same time, the initial intermediate product is slipped on the lock pine which, at that moment, plans the role of catcher. In the process of drawing, lock pin 3 plays the role of a clamp. To increase the possible height of the part being drawn, spring 1 and bushing 2, mounted on lock pin 3, returns the plate to the level of the surface of the die. In the process of changing the shape of the part, bushing 2 moves in a hole in the lower plate of the die. A clamp is introduced also in the upper part of the die (parts 7, 8, 9, 10).This clamp operates before the grips begin to move and prevents the lift of the part and the side motion.

Conclusions:

1. A system was developed and is being introduced for the automatic design of drawing dies for multipositional presses for drawing round parts with or without flanges.

2. Algorithms, simulating the design of the plunger and the female die for drawing round parts with or without flanges, are universal, and can be used to calculate any die of a typical design.

FOOTNOTES

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02291

Energomash Produces New Accurate Industrial Thermometer

18610197 Moscow IZOBRETATEL I RATSIOLIZATOR in Russian No 3, Mar 88 p 7

[Unattributed article:"Twice as Good as Japanese"]

[Text] An industrial thermometer became the key to the Moscow Oblast program at the "UR-88" Exhibition. A reader may say, "this is not news, that he has known dozens of models." True, but they are either cumbersome and difficult to lift, either expensive or inaccurate. At the Chekhovsk "ENERGOMASH" Plant, engineer Ye. Ustinov, mechanic KIP [Monitoring-Measuring Devices] K. Mitrofanov and psychologist V. Mashkin created a thermometer which is very small, accurate and inexpensive.

All three thermometers were made under house conditions. The following were utilized: a housing for fishing rods used for fishing under ice, common microcircuits and an available set of ratings. The circuits are so simple that they can be mass produced by schoolboys.

The developers are especially proud of the sensitivity of the thermometers. They achieved the self-compensation of the thermal emf of the cold soldered joint, since this is a guarantee of the great precision of the indicators independent of the temperature of the environment.

The device operates positively in a range from 20 to 1000 degrees centigrade with an error no greater than 1.5 percent. This is twice as good as a Japanese device of the same class that costs 1000 dollars and is incomparably better than the thermometer made by the Ternopolsk "Vetra" Production Association which is as complicated as a color TV and costs about 800 rubles.

The developers are convinced that in series production the device will cost no more than 25 rubles. Who will undertake to make the optimal thermometer for industry? Demand guaranteed.

02291

Two Million Ampere Switch Developed

18610427 Moscow NAUKA I ZHIZN in Russian No 2, Feb 88 pp 156-157

[Article: "Two Million Ampere Switch"]

[Text] All our readers probably turn lights on and off and plug and unplug appliances many times a day. In technical jargon, this is called making and breaking electrical circuits. Any of these actions leads to the release of heat. At home, where the power of the current is low, this heat is negligibly small, and therefore we can get along with small circuit breakers. When dealing with large currents, however, a great deal of heat is released, and circuit breakers are replaced with knife switches, which not only ensure reliable contact but also prevent the contact from overheating.

Existing switches can handle currents of up to several thousand amperes. What happens, however, when the current reaches 2 million amperes? None of the known methods can be used to break such a circuit. The heat that would be released in this event would melt everything around it. There is a good reason why the figure "2 million" was selected. This is the current level that arises during operations in, e.g., controlled thermonuclear fusion. An example of such a current in nature is lightning, which can pierce a layer of air several kilometers thick. Of course, it is impossible to create this kind of "gap" in a circuit breaker. This means that another way has to be found.

In solving this problem, associates of the I. V. Kurchatov Institute of Nuclear Energy Dr A. I. Nastyukha (physics-mathematics) and Ph.D. candidate Ye. A. Koltypin (physics-mathematics) detected new properties in an electric arc, the same kind that is used in electric arc welding.

The scientists established that, when the electrodes are in a certain configuration, the conditions for an arc discharge to occur are significantly improved. It was found that, in the space between the electrodes which create the arc, things form that might be called traps for the electrons escaping from the electrons' cathodes. When these electrons are concentrated, they gradually expend their energy on bringing about additional ionization of the gaseous medium. This latter fact also promotes the arc discharge.

The number of electrons caught in the trap can be increased artificially: just make the electrodes asymmetrical (by making the anode in the shape of a drinking glass). In this case the current in the arc will flow in only one direction. It is also this one-way conductivity of the arc that makes it possible to interrupt or pass currents of up to 2 MA and voltages of up to 25 kV.

This discovery was not of just theoretical importance. On the basis of it, powerful arc gas-discharge devices were developed. They have broad areas of application.

Exploiting the property of one-way conductivity, a "plasma arc gate" was designed on the basis of the discovery made by A. I. Nastyukha and Ye. A. Koltypin. This gate is a controlled diode which is capable of switching off pulsed currents of up to 200,000 A at voltages of up to 15 kV.

Another category of pulsed devices has also been developed: "plasma switches." These devices are being successfully employed in industrial technologies for machining metals using powerful pulsed magnetic fields. Scientists have been able to "teach" the zero-density field, which has none of our five senses, to stamp out parts and to perform clamping, drawing, punching, cutting and pressing operations. Of course, these operations can also be performed without a magnetic field. However, the new technology has a number of significant advantages over traditional methods: the load is uniformly distributed over the surface area of the blank, and clean and high-quality machining, as well as high efficiency, are ensured.

Plasma switches have found application in areas other than just industry. They are being used to prospect for mineral deposits on the seabed using the explosive seismoacoustic method, which makes it possible to collect information on the deposit layer on the ocean floor quickly and efficiently.

The Six-Chamber Plasma Switch Makes It Possible to Work with Currents of up to 1-1.5 MA. one central chamber in it and five peripheral chambers are milled in a common duraluminum housing. Each of the chambers is a hollow cold cathode. Water-cooled copper anodes are run into the chambers via insulators. In order to promote the arc discharge between the electrodes, the air in the chambers is pumped out. The central chamber is simultaneously the working chamber and the one which ignites the arc in all the other chambers. The electric arc makes it possible to discharge a bank consisting of six capacitors to a common inductance coil or, in other words, to a solenoid. In passing through the solenoid, a powerful (about 1.5 MA) high-voltage (about 25 kV) pulse of current creates a powerful pulsed magnetic field, which induces Foucault currents in the metal blanks inside the chambers and hurls them onto a punch. This completes the part. If the part is flat, no die is needed. These pulses can be repeated every 10 seconds. The stamping, cutting and pressing forces can be metered very accurately. This is simple to do: the energy is stored in the constant-capacity capacitor bank and consequently is dependent only on the voltage fed to it. In other words, the stored energy can be very easily regulated by regulating the voltage (and this can be done very accurately).

/9604

State Of Robotics, Lack of Componentry Discussed

18610012 Moscow SOVETSKAYA ROSSIYA in Russian 21 Aug 87 p 2

[Article by academician L. Koshkin under the rubric: "I Beg To Differ:" "The Drama of Conveyor Robots"]

[Text] I read with great interest the "round table" report "Shop Presents Bill to Robot" published in SOVETSKAYA ROSSIYA on 16 Jun 87. It presents a quite objective picture of the robotics situation in this country. Allow me to quote several basic inferences from the article: "Over the past five-year plan, only half of the robots produced have found application in practice. The other half, thousands of them, were either sent to warehouses or simply scrapped... Manufacturing was rejecting many designs due to their extreme unreliability, limited application, and huge cost...."

Indeed, how else can one react to the general implementation of robots in production when, as the participants of the "round table" conference found out after analyzing a number of enterprises, seven robots freed up overall only one worker! And the economic effect after spending 30-35 million rubles was less than 20,000 rubles. Need I say more.

True, some people may respond that any new undertaking involves expenses and losses without immediate benefits. This is correct. However, robotics is not a new thing. It appeared at enterprises some 20 years ago, which is quite a long time. Jet-powered aviation, radar, rocket technology, and nuclear power all appeared at about that same time and were extensively developed. All really progressive developments have demonstrated their advantage from the moment of inception in spite of the imperfections of first attempts. The first car, which may look funny today, was moving anyway, and moving faster than a horse-drawn carriage. The first airplane flew twice as fast as a car of those days.

It would be reasonable to expect a robot, which is a new technical solution, to "move" faster, that is, to release a man from hard labor and increase his productivity. And all this must be necessarily achieved at a lower cost compared with other types of technology. It also would be reasonable to expect that implementation of robots at an enterprise will pay for itself sooner than other types of automation. Alas, a different picture is presented in practice. Using robotics, hundreds of thousands of rubles are required to free one man. That is, robots will pay for themselves only after about 100 years!

Naturally, SOVETSKAYA ROSSIYA organized a "round table" discussion in order to determine the reason for this situation. The following are explanations for the inefficiency in introducing robotics as provided by proponents of robots. The director of the Main Technical Administration of Minstankoprom [the Ministry of the Machine Tool and Tool Building Industry],

V. Yefimov, blamed Minpribor [Ministry of the Instrument Making Industry] for supposedly not yet producing the necessary microprocessor control systems. The deputy director of the Department of Process Equipment and Tooling at Minpribor explained that it is the low quality of componentry which is restricting the level of our technology. He was supported in this by the deputy director of the Main Technical Administration of Minelektrotekhprom [Ministry of the Electrotechnical Industry], O. Nikonov: the most important problem is lack of componentry. Without these parts, robots cannot work reliably.

Thus, the problem is componentry. This conclusion, superficial even at first glance, is cause for alarm when you think about it: why does componentry play such a devastating role only for robots? After all, a wide variety of equally important componentry is required for aircraft, and they still arrive at their destinations. They are also required for rockets, and rockets still deliver interplanetary probes to Venus and even to Halley's comet. How is it that they don't have problems with componentry? Why is it that after all these years the lacking part sets have not been developed, when everyone is so sure that they alone cause the problem? Finally, why is there an infinite number of new robots being planned, when their designers understand that without proper supply of parts this technology will remain at the previous level? And why do we need to continue production of thousands of robots which cannot be used?

I want to disagree with the explanations given by specialists at the "round table". The cause of this high drama in manufacturing (and what else can one call such a widespread rejection of robots by manufacturing?) is different. Economics has its own laws, and any newly developed technology contradicting its laws is definitely going to be defeated by the more economically sound competitors.

Let us return to the initial task assigned to robotics: to replace man in the loading of a machine tool. Let the robot install a part onto, say, a lathe and remove it after machining. Of course, it is nice to watch such operations by robots in the shop. It works on the imagination: "A Robot Instead of a Worker" (by the way, headlines exactly like that appeared in many publications several years ago). But look at the robot from a different angle: while the lathe is machining the part, the robot is patiently waiting. Only when machining is finished does the robot become active again. As a result, this expensive technology (the price of a robot is, as a rule, several tens of thousands of rubles), is functioning only a very small part of the time. Can it pay for itself in this case? Of course not. This is because the productivity of process machines to which the robot is "attached" is, in this particular case, tens and hundreds of times less than that needed to make such "automation" economically necessary.

However, if the robot won't work for metal cutting benches, maybe it is applicable to faster machines like, for example, presses? A modern press processes 100 parts per minute. In this case also, the "human- like mechanism" becomes an obstacle, because now it has another disadvantage: it is slow at inserting parts under the press. Its productivity is only 7-15 parts per minute. That is, in order to service one such hydraulic giant 6-7 robots are necessary, which is technically impossible and, naturally, economically ineffective. In practice, it simply reduces press output by a factor of 10-15 compared to its design productivity.

Thus, "human likeness" has cost the robot dearly. It grips and transfers parts with a hand-like jointed "claw". The jointed design of this device, its nonrigidity, and the large travel it requires cause the slow operation of the robot.

Some people may object, then, that an economically feasibly automation of production does not exist at all. Before I answer this question, I want to quote an important thought from professor D. Lvov which, unfortunately, was lost during the polemical arguments in the press. Here is his idea: "In spite of the fact that the most complicated control systems are attached to the metal cutting machine tool and the processes of feeding and changing tools are automated, the principle of its operation remains in essence the same as it was many years ago. The cost of such machine tools increases tenfold, while the output doubles, or triples at best". There is the root of the problem. Today, we are trying to automate industrial machines that are already outdated. We "throw away" billions of rubles creating an inherently old technology, when new technologies would be literally hidden from view that are just begging to be brought from the laboratory into manufacturing. We, for example, are lagging behind the advanced countries in using composite materials, which have corrosion-resistance and strength superior to many types of steel, so that fewer parts are required. We have only started to develop powder metallurgy capable of revolutionizing the machining of parts (many parts simply do not require any machining). Laser technology is practically idling. I am saying all this to make the point that increases in productivity may be achieved by different, often combined, methods.

A new class of process machines has been called upon to provide, first and foremost, higher levels of labor productivity on the widest possible scale: rotor and rotor-conveyor lines. On these lines, the process operations are carried out during continuous joint transporting of the objects being processed and the tools (the simplest example of a rotor line is one for filling up milk bottles). This class of machines provides production automation and, at the same time, a quick return; that is, freeing up one person at a minimum cost of 3-5 thousand rubles, which is hundreds of times less than cost of robotization. I want to mention that in spite of the corresponding Government decisions, production of the rotor and rotor-conveyor machines is still lagging behind production needs. At the same time, a number of machine building ministries have still targeted an increase in robot production. I beg your pardon, but who needs so

many of them? We already build more robots than the USA and Japan together. Today, some people are trying to explain this increase as a new orientation: not on robot- manipulators but rather on process robots that weld, paint, and assemble. Supposedly, they will be more economically efficient. However, the basis of their design is again the "hand-like" robot scheme, namely, an attempt to copy a human being. I have already discussed why such an approach is destined to fail. I will add that the use of robotics for such simple operations as painting cannot be explained in general by anything short of the designers just falling in love with the idea of robotics, because this process may be effectively carried out by painting in a static field or dipping in a bath.

Some may object: what about the robots used in the developed Western countries? Capitalists would not install them to have losses. Firstly, they build fewer robots than we do. Secondly, the use of robotics is often subsidized by governments considering them to be good publicity and propaganda. However, the main reason is that robots are implemented only in those shops where it is profitable to replace a highly paid specialist. If the latter is paid 30-40 thousand dollars a year then, of course, it is better to install a robot for the same cost. Thus, to say that the whole Western world is oriented towards robots,—this is obviously a distorted picture.

What I am writing about our robots is not a discovery. Many specialists have already spoken about this. And the approach taken by machine builders has not changed. Instead of a serious analysis of the reasons why manufacturing rejects robots, they only express surprise, try to accuse their customers of, as it appears to them, sluggishness and reduce their own global failures to certain particular problems.

When the Machine Building Bureau of the USSR Council of Ministers was being created, everyone expected that from it would come concrete assistance for all that is new and promising in machine building, as well as help in forming strategies and follow-up expertise with the technology being developed. Presently, when under conditions of full cost accounting [khozraschet] and self-financing enterprises must literally count each ruble, it is this task which is growing in importance. Otherwise, we will not be able to aviod many more "dramas" in manufacturing.

13355

Titanium Nickelide Extends Robot Service Lifetime

18610015 Moscow STROITELNAYA GAZETA in Russian 21 Aug 87 p 4

[Article by S. Kashnitskiy from Tomsk and Kemerovo under the rubric: "New In Medicine:" "Metal Against Illness"]

[Text] **Two fingers tightly gripped a piece of porolon [polyurethane foam rubber]. A turn of the shoulder and the porolon is transferred to another place. The fingers opened and the hand returned to its original position. After that, everything was repeated again and again ...**

The model of a robot-manipulator was surprising not by the character of its movements, but rather by the fact that it seemingly did not require energy for doing its work: no power supply, no batteries, no induction coils. The condition for its non-stop action is very simple: there must be a flow of cooled air from a running table fan. Thus, under conditions of slight cooling the manipulator behaves as a free engine: it is running on energy received from the ambient medium.

The secret of robot's "tirelessness" is that the springs providing it with four degrees of freedom (grip, lift, turn, and grip release) are made of titanium nickelide, an alloy with thermomechanical shape memory. When the cool air from the fan slightly reduces temperature, the shape memory is "switched on", and the springs compress and move the mechanical arm. After leaving the cool air region, the shape memory is "switched off" and the returning springs provide the reverse motion.

A working model of the robot-manipulator was designed at the Department of Metal Physics of the Siberian Physico-Technical Institute at Tomsk University. This scientific collective, as well as the Department of Strength of the Problems of Mechanics Scientific-Research Institute at Leningrad University and the Metal Physics Institute of the Ukrainian Academy of Sciences in Kiev were the first three centers in the world to begin solving applied problems of using alloys with shape memory. Following the scientists from the USSR, scientists from the USA, France, West Germany, Japan, and China carried out similar studies.

The laboratories in Tomsk, Leningrad, and Kiev are the core of a future scientific and industrial association, the need for which is already urgent. The association will be able to implement new alloys in different fields of technology.

Today, the Tomsk metal physicists in cooperation with the Novokuznetsk Institute for Advanced Training of Physicians is successfully implementing titanium nickelide into medical practices. Several Siberian cities, namely, Tomsk, Kemerovo, Novokuznetsk, Tyumen, and Novosibirsk have inherited the world-wide fame of the trans-Ural city of Kurgan, where patients have been coming for two decades to see Dr Ilizarov, the developer of a miraculous method for treating fractures by building up bone tissue with the help of his apparatus.

Siberian doctors, introducing titanium nickelide into certain fields of traumatology, have advanced even further by developing osteosynthesis (bone joining) using the new method.

In the office of the director of the medical shape memory alloys laboratory, Viktor Eduardovich Gyunter, is a large box which looks like a case of drawing instruments.

Metal parts of different shapes, namely bent clips, wavy wires, "paper clips", "combs," and porous rods are placed in the soft plush indentations. Each of these parts represents a separate direction in traumatology and orthopedics.

There is one more remarkable peculiarity of the majority of these parts: almost all of them are implants, that is, they remain in the human body forever. High corrosion resistance, absolute nontoxicity, and compatibility with body tissues make possible the "internal use" of these clips, wires, and bone prostheses.

Porous parts made of titanium nickelide represent an especially important development in medicine. For example, a patient with a characteristic trauma, namely, part of the lower jaw is broken, enters the department of orthopedic stomatology at the Kemerovo Medical Institute. Professor M. Mirgazizov performs surgery to replace this area with a porous implant. This prosthesis is made using a specially developed technology, wherein a mixture of hydrofluoric and nitric acids opens pores of specified sizes. And soon after the surgery, the bone tissue grows through these pores and reliably connects the titanium nickelide part with adjacent bones. Thus, the prosthesis eventually ceases to be a prosthesis and becomes a part of the body. On the average, a month after the surgery lower jaw function is completely restored. Observations of former patients carried out after 3 months, 6 months, and 1 year show a strong bone connection of the implant with that part of the jaw which physicians call the mother bed.

Presently, the Siberian doctors together with the physicists from Tomsk are creating a new implant: artificial roots for teeth. A porous titanium nickelide cylinder is installed in place of the missing tooth. The bone tissue grows through it, and the cylinder is firmly secured in the jaw. After 3 months, a fastener for the dental bridge is screwed into the root section.

Professor Mirgazizov is working on introducing a robotic system, similar to the manipulator described above, for adjusting artificial dental bridges. It is a very complicated problem that is seldom successfully resolved in practice: building a lower bridge which can freely move relative to the upper in three planes. The structure of the jaw is unique to each person. To "guess" the patient's bridge geometry to within fractions of a millimeter is almost unrealistic.

Now, it will work, as follows: a gypsum model of the jaws with two bridges will be located in an articulator. Microprocessors will control the jaws movement (their motion will be similar to that of the robot- manipulator), and sandpaper "bitten" by artificial teeth will grind off the excess material. A microprocessor (instead of the simplified microcircuitry used in the manipulator) allows the jaws to move smoothly in contrast with the angular movements of the mechanical hand.

And there are the dogs, already frisking about the Tomsk Medical Institute, with special titanium nickelide "caps" covering up large stomach ulcers. Thus, there are great victories ahead over new illnesses.

13355

Use of Industrial Robots In the Automated Machining Line Equipment

81442033 Moscow TRAKTORY I SELKHOZMASHINY in Russian No 10, Oct 86 pp 44-51

[Article by Ye.A. Zhirnov, engineer ("NIItraktoroselkhozmash" NPO), under the heading "Production Technology, Organization and Economics"]

[Text] Large-series and mass production characterized by the use of special highly productive equipment with highly concentrated operations, demands that automation devices reduce blank positioning and part removal time to a minimum, which is to be explained by the brief machine processing time (40 seconds or less). A high percentage of the robots developed in other branches of industry do not meet these conditions, inasmuch as part replacement time (20-30 seconds) is a significant percentage of machining time, resulting in lower equipment productivity.

The possibility of rapidly readjusting a manipulator for another program is less important here than in small-series production. At the same time, good robot operating reliability is necessary because of the short machining cycle. Because the processes are highly specialized and discrete, there is less need for many positioning points in the working zone and less need for memory. The availability of complex, accurate hardware components requires rather high positioning accuracy (0.5 to 1 mm) when setting up parts.

Industrial robots with digital programmed control and positioning using rigid stops meet all these requirements; their two converging arms or grippers reduce part replacement time from 20-30 seconds to 3-5 seconds. Positioning using rigid stops ensures accuracies of 0.2-0.6 mm; the digital programmed control system is very reliable and is fully able to provide the necessary set of movements.

This type includes the "Pirin" gantry manipulators produced by the "Beroye" Robotics Scientific-Production Combine (PRB [People's Republic of Bulgaria]), designed for automatic loading and unloading of metal-cutting machine tools. Three versions are produced: PM40, PM80 and PM160, with load capacities of 40, 80 and 160 kg, respectively.

The gantry manipulators (Figure 1 [following page]) are independent systems equipped with a hydraulic unit 5 and a junction box 9. They include a gantry 1, a manipulator 2, a gripper 3, an enclosure 4 and a control

panel 7. (In Figure 1, 6 is the conveyor and 8 is the machine tool.) Manipulator 2 consists of a carriage to which two (sometimes one, sometimes 4) arms are attached; the arms are designed to be set automatically in the top position when the hydraulic system is switched off.

Figure 1 shows gantry manipulators with converging (a) and parallel (b) arms

Two fundamentally different manipulator arrangements are possible.

1. With converging arms in a plane perpendicular to the gantry axis (Figure 1, a).

In this case, the machine tool must have a rather wide open zone in which both arms can approach. The PM40 and PM80 manipulators are used with body-of-revolution parts.

The manipulator arms can be installed at various angles to vertical, but one, which is close to vertical, is immobile, while the other is articulated so as to make the convergence of the arms adjustable during installation. A gripper rotation module is installed on one or both arms. If necessary to detour an obstacle when moving the manipulator, the arms can be moved aside in the vertical plane.

The PM40 and PM80 manipulators are produced in six modifications with varying travels, inclinations and gripper rotation modules.

Basic Technical Data

	PM40	PM80
travel (run), in mm	250,350,500,600	350,500,600,1000
maximum speed, m/sec	0.6	0.6
positioning accuracy, mm	[plus or minus]0.25	[plus or minus]0.3
inclination of arm, in degrees:		
α	0-23	0-25
β	34-56	33-58

2. With parallel arms spaced along the gantry axis (see Figure 1, b). The arms are installed rigidly and vertically on carriages.

In such an arrangement, there are no restrictions on the shape of the part and no wide zone of approach is required, but the time required to replace parts is increased somewhat due to the necessity of shifting the manipulator carriage along the gantry. Moreover, the number of rigid supports required to stop the manipulator doubles and the gantry increases in length by an amount equal to the distance between the arms. Gripper rotation modules can be installed on one or both arms.

This arrangement is used in the PM40, PM80 and PM160 manipulators. Depending on the possibility of rotating the wrist, two modifications are produced for each version.

Basic Technical Data

	PM40	PM80	PM160
maximum:			
travel, in mm	600	1000	800
speed, in m/sec	0.6	0.6	0.4
distance between arm axes, in mm	600	600,945	630
positioning accuracy, in mm	[plus or minus]0.25	[plus or minus]0.3	[plus or minus]0.5

Proper selection of the necessary gantry version is important: two-, four- or multiple-support.

Two-support gantries are simple in design and the least metals-intensive, but inasmuch as both supports are in line with the gantry axis, the working run of the manipulator is very restricted, since all the equipment it services must be between the supports.

With four-support gantries, the dimensions of the devices being serviced can be outside the working run of the gantry, in which connection one need only set this run equal to the distance between the outside points being serviced.

The use of multisupport gantries, with the proper number of intermediate supports, removes any restrictions on the service length, but these can be used only for manipulators with parallel arms.

The supplier designs the grippers from the client's technical assignment in each specific instance, as a function of the shape of the parts to be machined and the approach zone of the machine tool.

Two types of gantry manipulator control are used: contact-relay and PK-1300 programmable-controller.

Gantry manipulators load and unload the metal-cutting machine tool and move parts to and from the transport device. Most often, this means special conveyor bins which ensure that the parts being transported will be oriented precisely and be where the gantry manipulator will pick and place them.

A series of such conveyors is series produced by the "Pobeda" KMM Metal-Cutting Machine Tools Combine in Sliven (PRB).

Two type-sizes of closed-vertical roller conveyors are manufactured, the KR-20 and the KR-50 (Figure 2, a).

Transport rollers with press-fit plastic friction sleeves are installed on driveshafts running the entire length of the conveyor at a certain pitch (82.5 mm for the KR-20 and 114.3 mm for the KR-50). The weight of the part satellite being transported creates friction between the shafts and the friction sleeves, and the torque created is transmitted to the transport rollers and the part satellite moves along the conveyor.

The use of a freely rotating pair of shafts and the transport roller friction sleeve ensures that the part and satellite will be stopped precisely where needed, using very simple removable stops 3 activated electromagnetically. At the same time, the shafts are pushed into the friction sleeves, and the transport rollers no longer turn.

The conveyor consists of separate sections 4-6 m long, each with its own drive station 4 which uses a chain 5 to start up one or another of the shafts on the forward and reverse runs of the conveyor. The rotation is transmitted from these two shafts to others in that particular section by two chains which run to all shafts in each run of that particular section.

In order to transfer the satellites from one run to another, lift stations 2 with built-in independent transport roller drives 1 are installed in each end of the conveyor.

Figure 2 shows roller (a) and chain (b) conveyors.

Basic Technical Data

	KR-20	KR-50
maximum weight of item transported, in kg	40	50
maximum load capacity per running meter, kg	80	180
transport speed, m/min	7.5	7.5
distance from floor to part axis, in meters:		
minimum	1100	1150
maximum	1250	1250
width at pedestals, mm	540	680
positioning accuracy, mm	[plus or minus]0.5	[plus or minus]0.5

The KV-150 vertical-closed chain conveyor (Figure 2, b) is also available. Its two transport chains are activated by a dual star-gear 1 drive station 2. Satellites 5 with parts are transported by the top chain and are returned to the loading place by the bottom chain. Special three-row chains with a pitch of 50 mm (rupture strength 11 tons) are used.

As in the roller conveyors, the satellite and part can be stopped at any point on the conveyor without switching on the system drive by using stops 3 which respond to a stop located below the satellite. That same satellite stop responds to a finger 4 on the axis of the turning sprocket, transferring the satellites from the bottom run of the chain to the top run.

KV-150 Conveyor Specifications

maximum weight of item being transported, in kg	150
maximum carrying capacity per running meter, in kg	400
linear speed of transport, m/min	2.5 - 7.5
maximum conveyor length, in meters	30
distance from floor to part axis, in mm:	
minimum	1100
maximum	1250
width, including oil pan, in mm	860
positioning accuracy, in mm	[plus or minus]0.5

Gantry manipulators are used as part of robotized technological complexes (RTK) or robotized automatic lines (RAL).

Standard RTK arrangements are shown in Figure 3. Scheme I is used in RTK servicing one machine tool 3 which includes loading 1 and unloading 2 devices as auxiliary equipment.

Scheme II shows the layout of an RTK for bending the straw separator crankshaft for the "Don-1500" combine. The complex is a development of "NIItraktoroselkhozmash" NPO for the "Rostselmash" plant. In view of the fact that it uses manipulators with converging arms, while bending machines 1 and 3 and the crankshaft itself are very large, the axes of the loading 2 and unloading 4 devices coincide. Special gantries with pedestals on the opposite side of the machine tool are used for easier access to service the equipment.

Standard RAL arrangements are shown in Figure 4.

Scheme I is used when each operation in sequence is assigned to one machine tool. The manipulator removes the blank from a satellite, which is stopped by pop-out stops at positions 1, 2 and 3 and puts a machined part in its place.

One conveyor is used to transport parts. Its entire length is used to store satellites with parts; the stock of parts which have gone through all the machining operations, including position 020, is put in sector 1-2, all which have gone through operations 025 are put in sector 2-3, and so on.

Figure 3 shows standard RTK arrangements.

Figure 4 shows standard RAL arrangements.

If one operation is duplicated on two machine tools, one conveyor can also be used for transport, with some modifications to its control system (see scheme II). In this case, the retractable stop at position 1 detains the satellite to replace a part which has gone through the first

manipulator pass, and the next satellite is simultaneously released to position 2, for similar part machining by the second machine tool.

In turn, the retractable stop detains this satellite at position 2 so the part can be replaced by the second manipulator, letting the satellite and part already machined at the preceding position pass. In this case, the conveyor must be free of stock in sectors 1-2 and 3-4.

If one operation is duplicated on more than two machine tools, scheme III is used to separate the parts moving on to a particular operation from those not moving on. Each manipulator servicing machine tools in a specific operation takes the blanks from one conveyor and sets the machined parts on another.

The first conveyor has satellites with parts going on to all operations, including position 015; the second—020, the third—025. In such a scheme, the floor space requirements increase, since the length of the gantries increases.

In certain instances, it is possible to create RAL without transport conveyors. Figure 5 shows these arrangements.

Figure 5 shows the RAL without transport conveyors, including the space, loading device, storage unit, and unloading device.

Given a small number of small pieces of equipment to be serviced along the transport axis, when an intermediate stockpile is not essential, several single-arm manipulators are rigidly coupled, with only one carriage as a drive carriage (scheme I).

The pitch of the manipulator arms corresponds to the distance between the equipment being serviced. The coupling is moved forward and back over distance S in sequence, and the part is transported forward with each new step, since it is grasped by the next arm each time.

If the part processing machine time is 4 minutes or more, as when machining housing parts, one can use a version in which they are sequentially transferred by two-arm manipulators suspended from one monorail.

Scheme I shows the layout used by the "Tashkent Tractor Plant imeni 50th Anniversary of the USSR" PO. In it, one manipulator services machine tools 1, 2 and 3. After taking the part from the loading device (ZU), it uses the two arms to replace the machined part on each machine tool in sequence, placing it in a free cell in the storage device (NU) and returning to its starting position above the loading position. A second manipulator suspended from the same monorail grips the part in the storage device, services machine tools 4, 5 and 6, and then transfers the part to the unloading device (RU).

Inasmuch as this scheme uses a manipulator with parallel arms, the monorail length is unrestricted.

As compared with the traditional layout, this arrangement offers an opportunity to significantly reduce RAL cost due to the absence of conveyors and the reduced number of manipulators, as well as an opportunity to save production space and, in a number of instances, to solve the problem of servicing machine tools employed in one operation (as is shown in scheme III).

In this case, the manipulator is servicing four machine tools employed in two operations, so the line cycle is half that of the part machine time on each machine tool. Each manipulator cycle consists of two sequentially performed subcycles. In the first subcycle, its route is as follows: ZU-1-3-RU-ZU; in the second subcycle: ZU-2-4-RU-ZU. The task is thus resolved without introducing additional mechanical devices, and with only a slightly more complex program.

The "NIItraktoroselkhozmash" NPO has developed an R505B industrial robot specialized to service metal-cutting machine tools in large-series production and delivered it for series production.

Its modular-unit design ensures a certain flexibility when incorporating the robot into specific RTK and RAL. The robot consists of arm turn, travel and lift (rocking) modules, wrist rotation modules, shift and gripper modules.

The robot is equipped with two grippers, to reduce machine-tool idle time while removing machined parts and positioning blanks. While a part is being placed in the cartridge, a second shift module permits each gripper to move independently. All instructions except for the shift and gripper working movements are confirmed by special sensors, increasing instruction execution reliability. The robot works steadily at an air pressure of 0.4 MPa and is relatively insensitive to air contaminants.

Five positioning points are situated at an angle to the arm's turn, increased to 275°, permitting servicing at least two machine tools, as well as incorporating the robots into machining lines in operation at the plants, locating the machine tools on both sides of the pass. The working zone of the robot is shown in Figure 6.

Figure 6 shows the working zone of the R505B robot.

R505B Robot Specifications

arm turn, in degrees	275
arm travel, in mm	600
arm lift (rocking), in mm	260
wrist rotation, in degrees	180
gripper shift, in mm	50
positioning accuracy along each coordinate, in mm	[plus or minus]0.5
gripping force, in kH	1.4
air pressure, in MPa	0.4-0.63

The robot possesses good load capacity for this class of machines (pneumatic drive), depending on the specific combination of modules. When equipped with arm rotation and dual shift modules and with two wide grippers, load capacity is 20 kg (two parts of 10 kg each). For a robot equipped with a wrist rotation module and one gripper, the total weight of the part and gripper is a maximum of 40 kg. If the robot has no local modules and is equipped with one gripper, the weight of the part and gripper can be a maximum of 80 kg.

The gripper design (USSR Patent No 631330) ensures reliable gripping of both the blank and the machined part in the very same collet, given an automatic cycle, regardless of the amount of material removed. The diameter of the parts gripped can be 40-80 mm, or 20-80 mm if additional teeth are installed.

A unitized UTsM-663 series-produced robot control is the robot control system.

The R505B robots are series produced for tractor and agricultural machine building at the Pavlodar Tractor Plant imeni V.I. Lenin and the Chuguyevskiy Experimental Precision Equipment Plant.

The "NIItraktoroselkhozmash" NPO has developed the R520 readjustable transport-storage device (Figure 7) for transporting shaft-type parts from one robot to another within an RAL and creating interoperation stockpiles. It can also be used as a loading robot at the start of a line and as an unloading robot at the end, with the loading and unloading of blanks being done by a transport worker.

Figure 7 shows the readjustable transport-storage device.

R520 Specifications

load capacity, in kg	15
number of blanks in storage bin	15-31
blank diameter in gripper zone, in mm	60-90
greatest flange (or local thickening) diameter, mm	150
blank length, in mm	250-600
type of drive	electric
control system	cyclical
method of travel programming	limit switches
positioning accuracy, in mm	[plus or minus]0.25
number of degrees of mobility (excl. gripper)	2
vertical travel (in mm) at 0.1-0.4 m/sec	150
distance between start and end positions, in mm	2200
width, in mm	650

The device links two robots and operates in three modes, switching automatically from one mode to another.

Mode I. There is a part in position 2, put there by the first robot on the line. Feed position 5 is relieved of the part by the second robot on the line. In this case, it is a straight transport cycle to move the part from position 2 to position 5, after which carriage 3, with the vertical-travel and gripper module, returns to the starting position shown in the drawing.

Mode II. If the second robot stops, manipulator carriage 3 automatically switches to part-storage mode if it has not received a signal to remove the part from position 5 for a certain period of time, so as to ensure uninterrupted operation of the first robot. The carriage begins moving along gantry 4. Contactless sensors stop the carriage as it approaches the last bed position on the run which is not occupied by shafts 1, and the part is set in that position. The manipulator is returned to the starting position.

Mode III. If the first robot stops and the second robot continues operating, manipulator carriage 3 switches to operating from the stockpile if it has not received a signal from position 2. The unloaded carriage approaches the row of parts lying on the bed, picks up the first one on the run, moves it to feed position 5, and then returns to the starting position.

After the first robot is switched on from position 2, the carriage automatically switches to basic mode: direct transport of parts from position 2 to position 5.

Along with transport and intermediate storage, the R520 design allows for blowing out central openings while the part is in the feed position and squeezing the butt of the part against the stop so as to eliminate errors which accumulate during transport. Moreover, it has its own air preparation system and one back-up pneumatic distributor with a hypothetical reach of 8 mm to build in additional devices for monitoring shaft size, orientation, and so on.

A reprogrammable control system is used when operating the device. Series-556 elements are used as the permanent memory devices, programming is in machine code, total memory is 4K, number of input channels is 80, number of output channels is 40.

In order to eliminate malfunctions promptly, the control panel indicates the program cycle number and input signal number being performed at any given moment, and all instructions are confirmed. In the event of an emergency shut-down, the devices use the input signal number to determine the route switch from which the signal is not being received. System dimensions are 600x400x1700 mm.

A prototype R520 is now being introduced at the Tashkent Tractor Plant imeni 50th Anniversary of the USSR.

This same plant has also introduced a shaft-turning RTK consisting of two semiautomatic 1713-F3 lathes, an R505B industrial robot, and input and output transport-storage devices (TNU). The complex is controlled by an UTsM-663 robot control unit.

In the event of multiple-product machining, an additional positioner is installed on the input TNU to create a specific dimension from the robot arm axis to the blank base.

A heat-treatment RTK designed to machine the crown of two type-sizes of differential bearings has been developed for the "Vladimir Tractor Plant imeni A.A. Zhdanov." Parts of each type-size are machined on only one of the two tempering stations available on the machine tool. Two programs are stored in the robot control system simultaneously and are activated in sequence, depending on what part is arriving for machining.

A shaft machining RAL using the R505B robot has been introduced at the "Tashkent Tractor Plant imeni 50th Anniversary of the USSR." The line provides a full cycle of shaft machining and consists of three robotized complexes: milling-centering, turning, and milling.

Figure 8 is a diagram of the line. In it, 1 is a crate of blanks, 2 is the robot control panel, 3 is the TNU, 4 is a semiautomatic MR-71 milling-centering machine, 5 is the R505B robot, 6 is the enclosure, 7 is a 1N713 semiautomatic lathe, 8 is a model DF semiautomatic key milling machine, 9 is a special 009-913 semiautomatic flute milling machine, 10 is the TNU control system, and 11 is the operator's workstation.

Figure 8 shows the shaft machining RAL, using R505B robots.

The line is provided with simple transport devices (of the gravity-feed hopper type) whose length is limited, due to the incline of guide vanes which ensure that the blanks are transferred properly. The height of the loading-unloading of parts on the transport device must correspond to the height of the blank placement in the process equipment. The use of very simple devices such as this is possible only for shafts with single-diameter bands moved out to different ends and serving as support surfaces when moving along the guides.

The inclusion of R520 transport-storage devices in the RAL permits machining parts of other configurations on these lines.

Using a specialized R505B robot, such a line has the following advantages over a traditional line based on gantry manipulators (see Figure 4) when strict minimal machining time conditions are to be met:

—the robot services two pieces of equipment, instead of one;

—it is not necessary to use a single-piece conveyor;

—production space requirements decrease by 20-30 percent;

—the two-sided linear placement of equipment, with shavings removal gutters and conduits, which is traditional in this branch is retained.

When building lines based on the R505B robot, consideration must be given to the fact that, if each subsequent operation is assigned to one machine tool, the robot operating cycle will consist of gripping a blank in the loading device, replacing it in the first line in the run with a part which has gone through the operation, replacing that part with a machine part on the next machine tool, setting the machined part in the loading device, and returning to the loading device.

If the exact same operation is duplicated on two machine tools, the robot cycle consists of two sequential subcycles. The blanks for each subcycle will be taken from one loading device; the parts will be stored in the exact same unloading device after each subcycle.

If one operation is duplicated on three or four machine tools, the robot program includes, along with the two sequential subcycles, another abbreviated transport subcycle for moving blanks from the loading device right to the unloading device, moving parts to a third and subsequent stations performing the exact same operation. In order to prevent the unloading device from mixing up the blanks and the parts, it is two-tiered. For the second line in the run, the robot takes a blank on one of the tiers and services another pair of machine tools performing the exact same operation; it transfers the part which has finished that operation on the first RTK through the transport subcycle and puts it in a specified position in the single-tier loading device.

The "NIItraktoroselkhozmash" NPO is currently developing "Recommendations on Using Industrial Robots in Machining and Painting Production Facilities and Tractor and Agricultural Machine-Building Plants with Large-Series and Mass Production." Along with expanded specifications and equipment-item products-mix data, these will provide descriptions of Bulgarian robots with position control systems, the RB-230 and the RB-211 painting robots. Descriptions will also be provided for auxiliary equipment and sample technical assignments for obtaining PRB robots.

The introduction of this progressive equipment at Minselkhozmash enterprises will permit significant improvement in labor productivity and production standards and a significant manpower savings.

11052/9604

Works Nominated for 1988 Azerbaydzhan State Prize

18610189e Baku BAKINSKIY RABOCHIY No 33, Apr 88 p 3

[Abstract] The article announces the names of authors, nominating organizations and titles or descriptions of works that have been nominated for the 1988 Azerbaydzhan SSR State Prize in science and industry. There are 23 works, plus nine textbooks.

The topics of the nominated works include the following: defects, atomic diffusion and photostimulated atomic processes in semiconductors; new methods of studying strength, stability and failure in mechanics of deformed solids: the molecular mechanics of interaction of polyene antibiotics with lipid membranes; development, production and introduction of new lubricant-coolants for machining; a new metal-saving process and equipment for producing magnetic-core sheets for electric motors; plasma machining of blanks made of heat-resisting steels and alloys; and spectroscopy of electronic and vibrational states of chalogenide and oxide semiconductors—effects of electric and deformation fields.

Among the nominated textbooks are titles: Pneumatic Control Components and Systems (Elementy i sistemy pnevmoavtomatiki); and Systems Programming [in Azeri].

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Greater Efficiency Materials for Ships, Other Uses

18610010 Moscow MASHINOSTROITEL in Russian No. 8, Aug 87 pp 40-41

[Article by N.M. Azarkin under the rubric: "At the USSR VDNKh:" "Exchange Of Experience"]

[Text] In order to promote savings in shipbuilding and to exchange accumulated advanced experience, an exhibition entitled "Using New Progressive Materials and Reducing the Materials Content of Parts in Shipbuilding" has opened at the Shipbuilding Pavilion of the USSR VDNKh [the USSR "Acheivements of the National Economy" Exhibition]. This article discusses those exhibits, which may be implemented in many machine building branches.

The introductory section of the exhibition deals with the task shipbuilders are faced with of saving ferrous and non-ferrous metals during the 12th Five-Year Plan. In spite of the fact that our country is foremost in the world with regard to production of steel, cast iron, and several non-ferrous metals, the demand for these materials is not completely satisfied. Moreover, each year the mining of raw materials is getting more expensive and, therefore, the necessity of using material resources in manufacturing industries more efficiently and rationally becomes more acute.

The goals of the 12th Five-Year Plan with regard to metal saving are very stringent. In order to realize them in shipbuilding a complex program for saving metals has been developed, which includes the problems of improving designs, technological processes, use of new high-strength materials, and organizational and economic measures.

Developments are presented for introducing laser technology into shipbuilding in order to improve technological processes and reduce the specific amount of materials. One of these is the Latus-31 laser installation. Laser heat treating carried out on this installation allows one to achieve from 3 to 6 times longer service life of parts. During laser processing of different steels (U8, St45, KhVG, etc.), a surface hardening effect takes place to a depth of up to tenths of a millimeter. The increase in the microstrength not only reduces wear, but also stabilizes the instrument parameters. The annual economic impact of the Latus-31 installation is 500,000 rubles.

During the 12th Five-Year Plan, plasma deposition of coatings for protection of parts operating at high temperatures, in aggressive media, or subjected to intensive mechanical action, will be widely implemented. Coating material (high-melting-point metals, oxides, carbides, silicides, borides, etc.) is introduced as a powder or wire into the plasma jet from a plasma generator, whereupon it melts, is atomized into tiny particles, and is sputtered onto the surface of the part at a high rate of speed. The use of plasma deposition of coatings provides the necessary corrosion durability of parts, and heat and wear resistance of products. Plasma generators are especially promising as a means for restoring parts and products that are worn out.

The exhibition has a section on manufacturing parts from metal powders, where the following process operations are carried out: powdering of pure metals or alloys, preparation of a powder charge of a specified chemical and granulometric composition, pressing (forming) a powder charge for obtaining blanks of the necessary shape and size, and baking the pressed blanks in order to provide them the necessary strength and physical and chemical properties. After baking, depending on the purpose and specific requirements, the parts either are sent directly for assembly or are submitted to additional processing: oil impregnation, calibration, galvanizing (zinc or chrome plating), and machining. Four types of parts are manufactured using the new technology. The economic impact from implementation of this section is more than 340,000 rubles. Reduction of labor intensity was 26,252 norm- hours and 31 tons of metal were saved.

Big savings can be achieved by using new high-strength materials. For example, three-layered corrosion-resistant weldable steel VSt3sp+12Kh18N10T+08Kh13 has been developed to replace the homogeneous steel 12Kh18N10T for manufacturing parts that work in contact with acidic, alkaline, chloride-containing, and other aggressive media. It is made using pack rolling in sheets 12...24 mm thick, area size (1400...1700) x (4000...7000) sq.mm, and mass of 0.64...1.45 ton. The three-layered steel is characterized by uniform distribution of its properties over the entire area of a sheet. This steel has good weldability. By using such steel, it is possible to save 236 kg of very scarce nickel per year and make the part service-life not less than 5 times longer.

Looking at the exhibits, it is possible to learn about a technology for manufacturing centrifugally cast blanks for making flanged bushings in standard sizes 220...1120 mm and mass from 50 to 1000 kg. These bushings are made of corrosion-resistant high-alloy chrome-nickel steel and are used for "Neptun" deadwood seals. In order to prevent the formation of any defects on the outer working surface of the bushing, the metal is cast in a rotating metal mold, the inner surface of which is painted with a fireproof paint. The fireproof layer thickness, temperature, and amount of metal being cast are specified by taking into consideration the standard size of the bushings. The section for manufacturing the bushing blanks with allowances for machining is equipped with centrifugal machines, the necessary process tooling, and custom equipment.

Presently, the series-produced Neptun seals with centrifugally cast bushings are installed in all Soviet-built ships and some ships being built abroad. Implementation of the technological process of manufacturing bushings from centrifugally cast stock allows one to increase the bushing utilization factor from 0.2 to 0.5, reduce the labor intensity of part manufacturing from two-thirds to one-half of the previous level, and increase the seal life by factor of 2 due to the use of more wear- and corrosion-resistant steel. The annual economic impact from this innovation is 170,000 rubles.

At the Ritm NPO [scientific-industrial association], a method of heat insulation of large diameter pipelines and cylindrical vessels has been developed. Shells of PS-1-600 foam plastic are used instead of foam tiles.

The shells are made of a powdered polystyrene composition using specially designed and built equipment. The equipment design is determined by the size and shape of shells specified by the customer. Batch production of shells has been organized. Productivity of the working equipment is 80 shells per shift. With the improvements in the technological process and equipment for shell production, the price of one shell with a mass of up to 4.5 kg may be reduced to 6 rubles.

The advantages of using shells instead of tile material are that the material consumption is reduced by half; labor intensity of insulation work is three times lower; EP-0010 epoxy glue consumption is reduced by 90 percent; and the insulation is reliable and may be repaired. The economic impact of using 1 ton of shells is 4,000 rubles.

Adem-NSh-2 and Adem-T coatings are used inside hulls for reducing vibrations, and the noise caused by them, of hull structures, foundations, frames, pipelines, and other structures and equipment. The mastic is prepared by mixing component ingredients and is applied with an air atomizer or a putty knife. The thickness of the applied coating is 1.5 to 2 times greater than the thickness of the vibrating element. The mastics are applied layer-by-layer at 4...8 mm per day at a temperature not less than +5 degrees C.

The Adem mastic makes it possible to get damping parameters of coatings which are twice as good within the specified frequency ranges as compared with the regularly used coating; the coating mass is reduced by as much as 50 percent per damping surface unit; the labor intensity of preparing and applying coating is reduced to one-fifth to one-eighth of what it was before, and the coating materials cost a fifth as much; and glues and clamping tools are done away with. The mastics ensure that the coatings wil be reliable in operation and their sanitary and chemical characteristics will correspond to the requirements of sanitary inspection authorities at the specified saturation and temperature. The annual economic impact is 190,000 rubles.

Among the many examples of the importance of organizational and economic measures for reducing materials content in shipbuilding production, a stand demonstrating the use of computers in a system for controlling the materials content in production deserves attention.

The use of computers is highly efficient in reducing the materials content of series production with regard to criterion-based real-time selection from a large product mix of those parts and assembly units which most substantially affect the level of materials content. In addition, the computer calculates the given parameters of materials content. The following values are accepted as such parameters: theoretical mass of a part; mass of a stock part; value of waste mass; and integral values of the mass of parts and stock calculated per one assembly unit.

The developed software did the job of calculating the actual indices of materials content of the parts; of selecting parts based on given limits on the parameters of materials content; of selecting parts as manufactured from actual materials; of calculating expected value of material savings when the utilization factor reaches the planned value; and of calculating materials content with regard to groups of materials. The output documents are: parts lists ordered according to one or several parameters

with a printout of basic data that went into the assessment of materials content of the products; the designation of the part and of assembly unit it belongs in, the number of parts, the material code of the part, theoretical part mass, consumption norm, material utilization factor, mass of waste, and efficiency of replacing the materials being used with more progressive materials.

These lists are used by design and process services to carry out analysis of the actual materials content of series production and to improve the product with regard of increasing materials content parameters. The software uses the specifications and material norms information data bank operating at the enterprise within the ASUP [automated production management system] framework. The annual reduction of manual labor involved in information search and processing is 2,050 man-days. The annual economic impact is 12,700 rubles.

13355

Worker Input Into Manufacturing, Quality Sought
18610011 Moscow PRAVDA in Russian 6 Sep 87 p 2

[Article by S. Roginko, Candidate of economic sciences, Moscow, under the rubric: "Urgent Tasks: Increase Machine Building Development:" "Workers Conduct Search"]

[Text] **The most important goal of machine building is to achieve the highest level in the world with regard to manufactured machines, equipment, and instrumentation. The ministries of the machine building complex and the machine building enterprises themselves must solve this State- and Party-wide task in the next few years. This can be accomplished only by bringing all possible reserves to bear.**

The main reserve is people, the machine builders themselves and their active, interested participation in the qualitative improvement of their branch of industry. Only daily struggle to raise the technical and economic level of production and products will provide the anticipated results. One of the promising ways of attracting broader masses of workers are quality teams. This article discusses them.

I think everyone will agree that there is no kind of quality control of machine building products, important as it may be, which will fully solve the problem. Quality does not come from the outside, it is created inside at each work station. This by itself suggests the activization of the human factor and the discovery of the creative potential of a worker.

Ways to do this exist already. One of them is the quality team widely used at machine building and other enterprises in many countries. What are they?

A group of workers which work, as a rule, at the same production section voluntarily unite in order to jointly resolve problems of production efficiency and product quality. Such a group usually has from 3 to 10 workers who get together two or more times a month. The list of issues is wide-ranging: product quality improvement, maintenance improvement, development of processes and labor organization, reduction of cost, and improvement of work safety.

Let us note that it is the workers themselves who find the problems, who analyze them, search for solutions, prepare concrete proposals and who implement them with the help of management, if necessary. Team members and their leaders study statistical quality control methods and techniques of analyzing situations and decision making. A "package" of these methods is reduced to a standard set, which must be learned by each member of the team.

This set is also studied by all ranks of supervisors and managers. The goal here is to facilitate understanding between the teams and management, which is responsible for any decisions. At the same time, managers are required in every possible way to support the work of teams and, above all, to cooperate in the timely introduction of their proposals.

The experience of using these teams abroad demonstrates their high efficiency: the payoff is in the billions of dollars. In addition to direct savings, we are impressed with another very valuable result: workers' attitude toward everyday work changes, absenteeism is down, and discipline is improved. All this creates at the enterprises a moral and psychological atmosphere which precludes passivity and low-quality work.

The introduction of quality teams at a socialist enterprise promises even higher results.

We will tell you about the first steps taken by these teams at our enterprises. Their appearance was the result of actions taken by motivated managers and enterprise collectives, which have taken an active position in mastering world experience in the forefront of management techniques. The first results are already available: cost reductions, increase in product quality, and savings in materials and other resources. For example, at the Vatra Production Association in Ternopol the proposals of quality teams has substantially improved lighting equipment quality. Parts arriving at the assembly conveyor lines are are showing more care in machining; rejects during the main process operations such as casting, plating, and stamping have decreased. The work of quality teams at Riga's Avrora Factory has helped to decrease the losses from rejects by two-thirds.

The introduction of state acceptance [gospriyemka] provides an additional stimulus for organizing quality teams. Enterprises placed in difficult conditions mobilize all reserves, and the quality teams here are one of the

most important ways to meet the new requirements. For example, during their preparation for state acceptance, members of one of the quality teams at Kazan's Teplokontrol PO [production association] carried out certification of the work stations, revised technical documentation, and proposed concrete measures for improving labor organization.

Quality teams at our enterprises demonstrate great activism in solving social problems. By the way, this feature is absent in capitalistic countries, where the priority is on production goals in order to increase the profits of the corporations. Indeed, at some of our enterprises, especially those where social problems have been neglected, the problem of improving working conditions is the first thing to be discussed. In particular, at Tula's Chayka Sewing PO, the management was seriously surprised by the fact that the overwhelming majority of proposals introduced by the quality teams had a social character. However, there was nothing to be surprised about: the reason was management's lack of attention to working conditions.

"Our quality teams work, but do they work right?", leaders and initiators of these teams are asking more often lately. A new problem is appearing: shortage of information about the work of teams, primarily in machine building branches. Anyone who has tried to start a team has felt the information "hunger". One can see the passive attitude of the USSR Gosstandart [State Committee for Standards] in the field of methodology and organization, and in the absence of a well-organized dissemination of domestic and foreign experience. There are very few publications explaining how teams must operate. Useful examples from domestic and foreign practice are literally fished out a little at a time by those who are enthusiastic about it. Very often due to the lack of basic knowledge, the teams "reinvent the wheel".

However, in spite of the data shortage, the problems of methodology are nonetheless being solved. Already, testing of methods developed at branches and enterprises is being carried out in a number of places. Labor unions have taken a constructive position in this matter. The VTsSPS [All-Union Central Council of Labor Unions], which only recently got involved in these activities, has started introducing the new form of worker self-management at the nation's enterprises.

However, a center for coordinating the work of quality teams at the All- Union level is needed. This center must be an authoritative body with a high social status and must have qualified full-time staff, able to organize the work of teams, their cooperation, and exchange of experience. It is this center which must become the main authority for organizing conferences, studying the world's experience, and providing methodological support to the teams. The time for amateurs and lonely enthusiasts is passing. Great success may be achieved through coordinated mass action.

The teams need organizational support from management and social organizations of the enterprises and associations. Firstly, it will speed up implementation of the workers' proposals and create feedback between enterprise management and the workers who will actually carry it out. We should also consider the creation of branch and regional organizations of quality teams and the unification of this movement at the All-Union level or, to start with, at least at the machine building complex level.

Even more possibilities for democratization exist where the quality teams can effect proposals concerning not only their own work stations, but also those of adjacent sections, shops, functional and supporting sections, and divisions. Cooperation among teams from different shops and divisions will allow them to bring up and work through the problems of the whole machine building enterprise at the level of the simple workers.

In a team where each member has at his command the methods for analyzing and resolving problems, a special moral and psychological atmosphere is created. This is connected with the fact that people, who before were simply executing orders, have found an element of creativity in their work. Independent search is a means of self-expression, which changes the quality team into a "team for shaping people". And it is possible that this is their main function.

The use of quality teams at enterprises is specified in the Decree of the CPSU Central Committee "On Measures for Radical Improvement of Product Quality". In spite of the seeming simplicity of teams, implementation them is not an easy matter. Attempts to resolve this problem by jumping in headfirst, without any preparations, leads to an oversimplification of the idea. A race to create a large number of teams and involve a high percentage of workers in their work turns out to be just another campaign.

Therefore, those managers who want to organize these teams for real, rather than on paper, must find the time for organizational preparation, propaganda work, and problems of methodological and material support.

13355

Low-Alloy, High Speed Steels for Drills Tested

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[Article by A.B. Aleksandrov, engineer, B.D. Danilenko, candidate of technical sciences, docent, P.P. Seredin-Sabatin, engineer: "The Physical-Mechanical Properties of New Grades of Low-Alloy, High Speed Steels"]

[Text] **Results from studies of impact strength on bending, heat resistance, coefficients of linear expansion and thermal diffusivity of these high speed steels are presented:**

11M5F, R2M5, EK-41, ROM3F3-MP and 12M5F3SYu. Also, the torsional rigidity of twist drills made from these steels is studied. For comparision, studies were also made of R6M5 steels subjected to two alternative heat treatments. Basic physical-mechanical properties were studied for various temperatures.

Qualitatively new materials, including more economical tool materials, are being more extensively introduced in the modern tool industry. Because of the scarcity of the basic alloy components used in high speed steels the industry's work on low alloy steels, in particular tungsten-free high speed steels, is important. In some instances the tools made from such steels have lower cutting properties than traditional grades. However, because scarce alloys are not used, such tools are economically advantageous for some types of production operations.

To objectively evaluate new grades of low-alloy high speed steels it is necessary to study not only their cutting properties but also their basic physical-mechanical properties. This helps in more precisely determining the rational areas for their use, as, in the final account, the initial physical-mechanical properties also always determine cutting properties. In addition, in many cases research on a tool material's basic properties substantiates conclusions obtained from strength tests of tools.

Below are presented results from studying several physical-mechanical properties of five new grades of low-alloy high speed steels: 11M5F, R2M5, EK-41, ROM3F3-MP and 12M5F3SYu, which were used to manufacture twist drills. The chemical composition of the steels studied is given in Table 1. For the possible comparative evaluation of low-alloy high speed steels, parallel studies were made of the properties of R6M5, the most widely used steel today. It was subjected to two alternative heat treatments: standard two temperings at 550°C and an initial low temperature tempering at 350°C [1]. ROM3F3-MP steel was produced by powder metallurgy methods.

As tool steel's properties are always manifested at elevated temperatures, it is also desirable take into account their changes at elevated temperatures when studying their physical-mechanical properties. Some properties of low-alloy high speed studies were determined over a range of temperatures including possible cutting temperatures.

The methodology for the statistical processing of results from research on the strength properties are given in [2].

Impact strength. Tests were conducted according to GOST 9454- 78. A 10x10x55 mm notch-free sample was used [1]. The results from measuring impact strength a_k are given in Table 2. It is obvious that the impact strength of various grades of steel differ, some substantially. Research on the wear of twist drill cutting edges showed that it is possible to make an indirect evaluation of cutting tool strength for low-alloy high speed steels by using impact elasticity. This has been previously noted in comparing mechanical and operating properties of ordinary high speed steels [3]. It turned out that the impact strength of the low-allow steels R2M5, 11M5F and ROM3F3- MP were higher than that of R6M5. As expected, the impact strength of powder steel was very high, and that of EK-41 steel very low, confirming results from production testing of these steels [4]. The a_k of R6M5 subjected to additional low temperature tempering turned out to be several times greater and the spread of testing results less. R2M5 steel test results had the greatest stability (a 5.3 percent coefficient of variation).

Bending strength. Bending tests were according to GOST 14019- 80 on a 6x6x45 mm sample. Test results are given in Table 2 and in general repeated the results for impact strength. Bending test results were somewhat more stable.

The torsional rigidity of twist drills. The torsional rigidity of twist drills is determined by the plasticity of tool material and has a great effect upon tool life. Research on torsional rigidity was conducted on 10.00 mm (GOST886-77) drills using a special device based upon a vertical drill.

Figure 1 shows the torsional rigidity of twist drills made from various grades of high speed steel: 1—R6M5, EK-41; 2—ROM3F3-MP; 3—11M5F, R2M5.

Figure 2 shows the thermal shock resistance of low-alloy high speed steels: 1—R6M5; 2—R6M5 (III); 3—EK41; 4—11M5F; 5—R2M5; 6—12M5F3SYu; 7—ROM3F3-MP.

The drill bit was attached to the spindle, the twisting angle was fixed with the help of a rotating table, and the torque with the help of a special drill testing machine. The relationships characterizing torsional rigidity for drills made from varous grades of high speed steel are shown in Figure 1. It was discovered that drills made from 11M5F, R2M5 and ROM3F3-MP low alloy steels have lower torsion rigidity than those made from R6M5, this agrees with measurements of a_k and gs$_i$. Drills made from EK-41 steel have rigidity roughly similar to those made from R6M5. Drills made from ROM3F3-MP powder steel have the least torsional rigidity. This is a result of this steel's high ductility, something also shown by measurements of a_k and σ_i.

For the average torque arising during the use of 10.0 mm drills the reduction in torsional rigidity of drills made from low-alloy steels is about 12 percent. This should reduce tool life by a factor of about 1.3 [5].

Thermal shock resistance. The thermal shock resistance of the steels studied was determined by measuring the hardness after they were kept at 560, 580, 600, 620, 630 and 640°C for 4 hours. It should be noted that when samples are heated to 640 there is a sharp drop in

hardness for all steels (down to Rockwell hardness 51-55) Figure 2 shows results from measuring the hardness of samples heated to 560- 620°C. It is obvious that 11M5F steel has the greatest thermal shock resistance, and that EK-41 has sufficiently high resistance (at temperatures over 620°C).

Coefficient of linear expansion. The coefficients of linear expansion, measured according to the methodology in [6], are given in Table 3. An analysis of the data obtained shows that, at low temperatures the value for α is about equal for all steels studied, high and low alloy steels having high values for α. The inflection of the curves $\alpha = f(\theta°)$ in the 350-400°C range are evidence of rearrangement in the lattices of high speed steels at these temperatures.

Figure 3 shows the temperature dependence of thermal diffusivity of low-alloy high speed steels: 1—ROM3F3-MP; 2—11M5F; 3—R2M5; 5—EK41; 6—12M5F3SYu.

Thermal diffusivity. One of the most obvious indicators of the temperature field in a cutting tool is the tool material's thermal diffusivity, *a*, defined as $a = \lambda/(c\rho)$, where λ is the coefficient of heat conductivity, *c*—specific heat, and ρ—density.

In contrast to λ which characterizes a body's ability to conduct heat, *a* characterizes a body's thermal inertia and is a measure of the speed with which the temperature field in the tool reaches equilibrium. The value of thermal diffusivity is determined by λ and *c* and is measured by the methodology in [6].

Figure 3 shows the relationship $a = f(\theta°)$ for various grades of low-alloy high speed steels. This relationship differs for various grades, however, at tool working temperatures. Grades 11MrF and R2M5 have the highest heat diffusivity.

Conclusions

1. 11M5F low-alloy high speed steel has sufficiently high indicators for a whole series of physical-mechanical properties.

2. The use of additional low temperature tempering of R6M5 improved its physical-mechanical properties. This was was especially vividly shown at elevated temperatures.

3. In order to make a final decision about the possibility of using these steels to make cutting tools it is necessary to carefully study their cutting properties under various cutting conditions. Also, their manufacturing process properties must be taken into account.

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11574